July 1983
vol. 9, no. 7
$2.95

Focus On Graphics!

creative computing®

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In-Depth Evaluations:

- Jupiter Ace Computer
- CompuCorder
- Audex
- Sight 'n Sound
- Vic Music Synthesizers
- GEAP Dot Writer
- The Graphics Solution
- Newtrieve
- Quik-Vis
- Transparent Sort
- Pursuit Of The Graf Spee

Interview With Saul Bernstein: Pixel Picasso

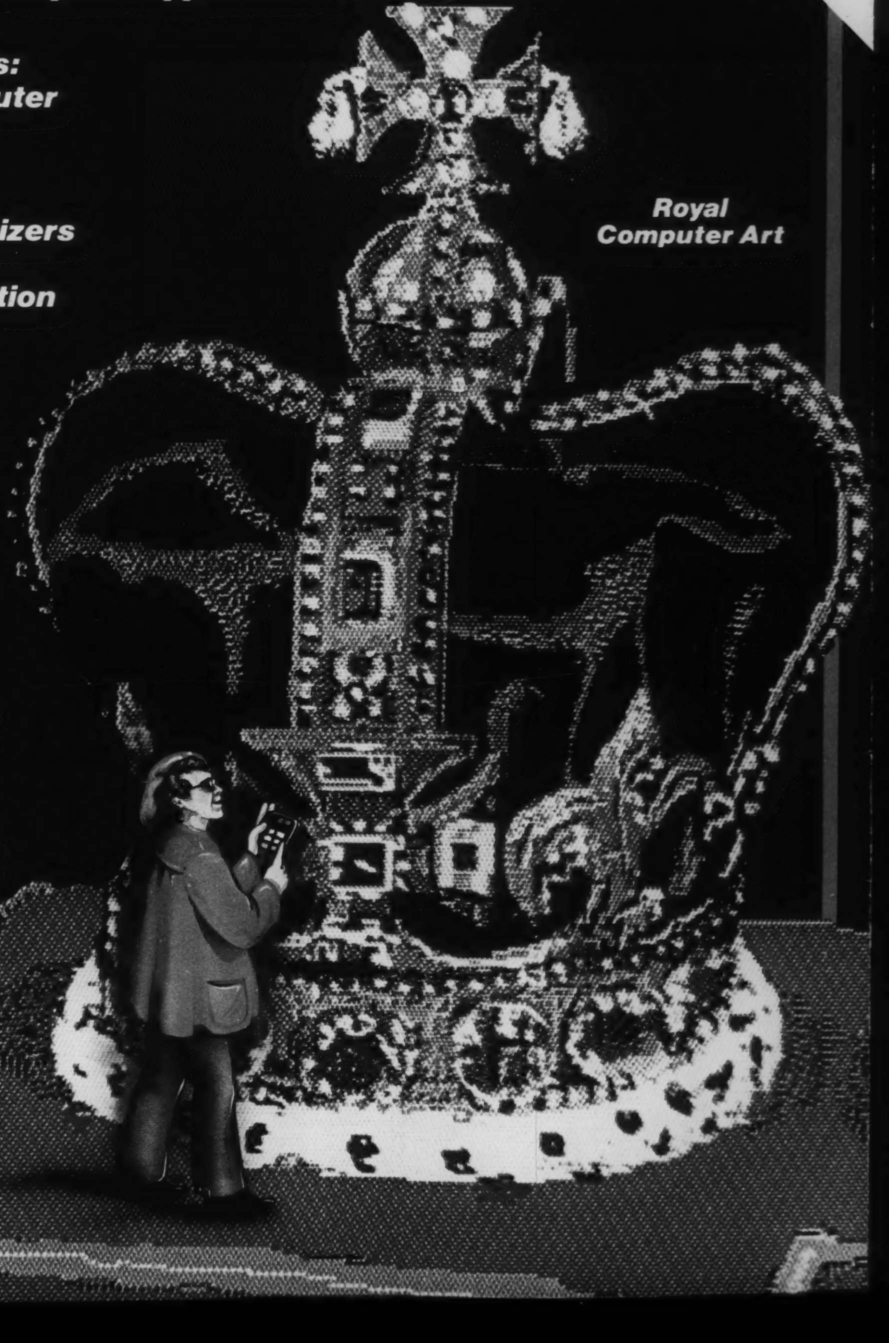
Report On Music Synthesis

Graphics Programs For Apple, TRS-80, Atari, Vic, IBM

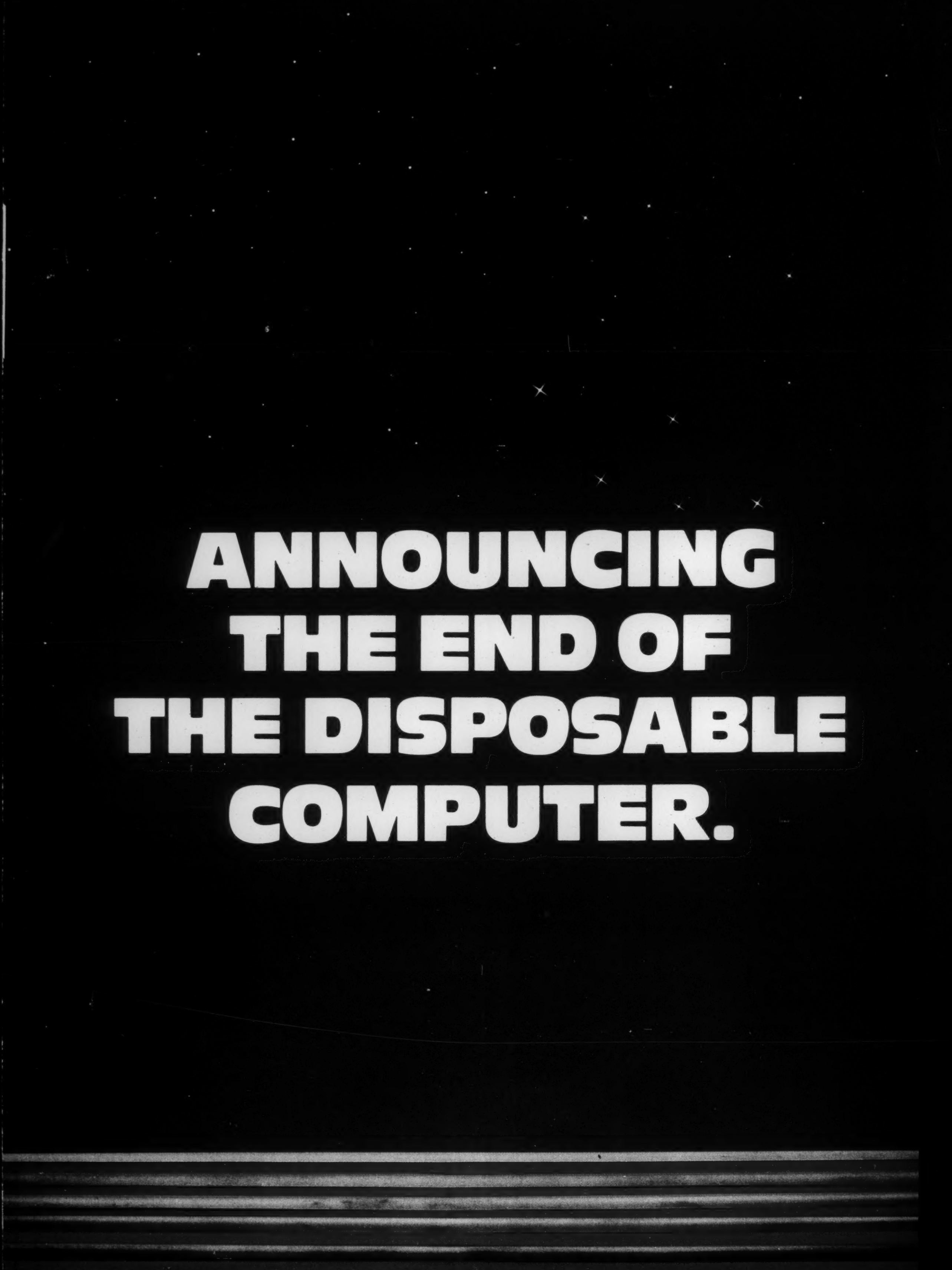
Apple Sound Tables

Layman's Guide To Disk Protection

Sailing Tutorial



Royal Computer Art


ANNOUNCING
THE END OF
THE DISPOSABLE
COMPUTER.

THE REMARKABLE
SV-318 PERSONAL COMP

You'll grow into it, not out o

SPECTRAVIDEO
SV-318
FOR

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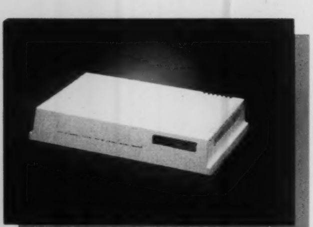
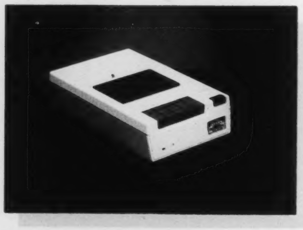


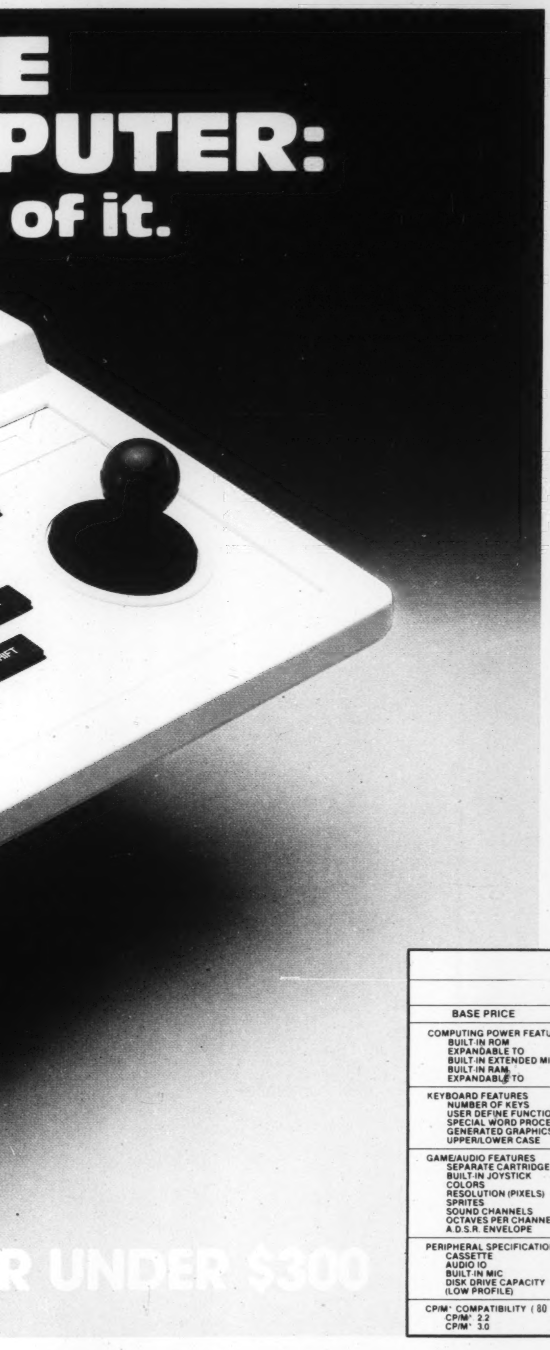
SV-601 SUPER EXPANDER

The real value in any computer system lies in its ability to accommodate a large variety of input/output devices simultaneously. With the addition of the SV-601, the SV-318 can interface with as many as seven different devices at one time. Although lightweight, the SV-601 can support a 15" T.V. monitor. Special front view slots have been designed to monitor the operation of the different interface cards that are connected to the system.



SV-903 DATA CASSETTE

This feature packed data cassette draws its power from the SV-318, to which it is handily connected. By using a stereo head, you can record data on one channel and voice or sound on the other. This greatly enhances the usage of cassette stored data. Programs such as foreign language tutorials and voice assisted training can be used and data stored. The data cassette will continue to be an integral part of your system even if you choose to expand into a disk drive. The data cassette even has a built-in condenser mic to help you write your own voice support programs.



Man has only recently tested the waters of the home computer age, and he has found the waters to his liking. But with a brain capable of storing several trillion bits of information, he will be continually pushing his new found toy to greater limits. Will his machine live up to this challenge?

Sadly, many personal computers will become tomorrow's junk in the attic. The SV-318 is one that will not. Because as you get better, it gets better. It does so because of its capability and expandability—both far beyond those of any other affordable computer.

CAPABILITY. The SV-318 isn't just more capable. It's much more capable. No other computer at even twice the price combines all these extraordinary features: 32K ROM expandable to 96K; 32K RAM expandable to 144K; Extended Microsoft Basic (the industry standard); even Standard CP/M 80-column capability so you can immediately utilize over 10,000 existing software programs. The SV-318 also has a unique built-in joystick/cursor control—an immeasurably useful feature when it comes to playing your favorite video game.

EXPANDABILITY. As you become more and more skillful with computers, you'll love how the SV-318 "stretches" to meet your demands (and actually leads you in fascinating, new directions). For one thing, all eleven of our important peripherals are available immediately. With most other models, you have to wait months. For another, the SV-318 is beautifully designed to interface with new options as they become available.

AFFORDABILITY. The SV-318 is not only eminently affordable, it's the first true bargain of the computer age! Besides home budgeting, business applications, word processing, programming and self-teaching, the SV-318 is the best entertainment value in town. Not only can you use it with your TV to play hundreds of different video games, you can also use your SV-318 with a TV as a drawing tablet or music synthesizer. In play, as in work, the SV-318 will continually expand to meet your potential.

Whether you're just wetting your toes in computers, or fully asail on the waters, the SV-318 is a computer that will serve you for many, many years. You see, we believe that even in the computer age, you don't become an object of real value unless you're around for a while.

SPECTRAVIDEO SV-318 COMPUTER COMPARISON CHART

	SPECTRAVIDEO SV-318	APPLE II PLUS	ATARI 800	COMMODORE 64	NEC 6001	RADIO SHACK COLOR COMPUTER
BASE PRICE	**$299**	**$1,540**	**$899**	**$595**	**$399**	**$299**
COMPUTING POWER FEATURES						
BUILT-IN ROM	32K	12K	10K	20K	16K	8K
EXPANDABLE TO	96K	N/A	42K	N/A	32K	16K
BUILT-IN EXTENDED MICROSOFT* BASIC	YES	YES	ADDITIONAL COST	NO	YES	ADDITIONAL COST
BUILT-IN RAM	32K*	48K	16K	64K	16K	4K
EXPANDABLE TO	144K**	64K	48K	N/A	32K	16K
KEYBOARD FEATURES						
NUMBER OF KEYS	71	51	61	66	71	55
USER DEFINE FUNCTIONS	10	N/A	4	8	10	NONE
SPECIAL WORD PROCESSING	YES	NO	NO	NO	NO	NO
GENERATED GRAPHICS (FROM KEYBOARD)	YES	NO	YES	YES	NO	NO
UPPER/LOWER CASE	YES	UPPER ONLY	YES	YES	YES	YES
GAME/AUDIO FEATURES						
SEPARATE CARTRIDGE SLOTS	YES	NO	YES	NO	NO	NO
BUILT-IN JOYSTICK	YES	NO	NO	NO	NO	NO
COLORS	16	15	128	16	9	9
RESOLUTION (PIXELS)	256 x 192	280 x 160	320 x 192	320 x 200	256 x 192	128 x 64
SPRITES	32	N/A	4	8	N/A	N/A
SOUND CHANNELS	3	1	4	3	3	1
OCTAVES PER CHANNEL	8	4	4	9	8	10
A.D.S.R. ENVELOPE	YES	NO	NO	YES	YES	NO
PERIPHERAL SPECIFICATIONS						
CASSETTE	2 CHANNEL	1 CHANNEL	2 CHANNEL	1 CHANNEL	1 CHANNEL	1 CHANNEL
AUDIO IO	YES	NO	YES	NO	NO	NO
BUILT-IN MIC	YES	NO	NO	NO	NO	NO
DISK DRIVE CAPACITY	256K	143K	96K	170K	N/A	170K
(LOW PROFILE)	YES	NO	NO	NO	NO	NO
CP/M* COMPATIBILITY (80 column programs)						
CP/M* 2.2	YES	NO***	NO	NO****	NO	NO
CP/M* 3.0	YES	NO	NO	NO	NO	NO

SV-902 FLOPPY DISK DRIVE

This extremely compact, low profile unit uses standard 5¼" flexible diskettes. Its single side double density configuration allows a capacity of 256K bytes of data (unformatted). Linked to the Super Expander, the SV-902 is your key to the virtually unlimited scope of CP/M O/S as well as a complete variety of program languages such as LOGO, PASCAL, FORTRAN, COBOL and PL-1.

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SV 318

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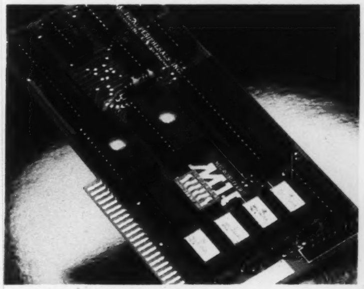
Microbuffer will instantly increase your efficiency — and eliminate the frustration of waiting for your slowpoke printer.

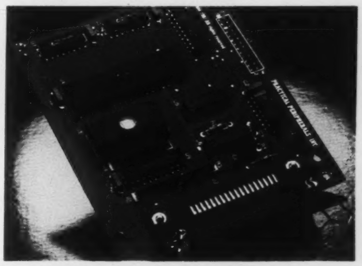
Now you can simply dump your printing data directly to Microbuffer and *continue processing*. Microbuffer accepts the data as fast as your computer can send. It stores the data in its own memory buffer, then takes control of your printer.

THERE IS A MICROBUFFER FOR ANY COMPUTER/PRINTER COMBINATION.

Whatever your system, there is a specific Microbuffer designed to accommodate it.



FOR APPLE II COMPUTERS, Microbuffer II features on-board firmware for text formatting and advanced graphics dump routines. Both serial and parallel versions have a power-efficient low-consumption design. Special functions include Basic listing formatter, self-test, buffer zap, and transparent and maintain modes. The 16K model is priced at $259 and the 32K, at $299.



FOR EPSON PRINTERS, Microbuffer/E comes in two serial versions — 8K or 16K (upgradable to 32K) — and two parallel versions — 16K or 32K (upgradable to 64K). The serial buffer supports both hardware handshaking and XON-XOFF software handshaking at baud rates up to 19,200. Both interfaces are compatible with standard Epson commands, including GRAFTRAX-80 and GRAFTRAX-80+. Prices range from $159 to $279.

MICROBUFFER

ALL OTHER COMPUTER/PRINTER COMBINATIONS are served by the stand-alone Microbuffer In-line.

The serial stand-alone will support different input and output baud rates and different handshake protocol. Both serial and parallel versions are available in a 32K model at $299 or 64K for $349. Either can be user-upgraded to a total of 256K with 64K add-ons — just $179 each.

SIMPLE TO INSTALL.

Microbuffer II is slot-independent. It slips directly inside the Apple II in any slot except zero.

Microbuffer/E mounts easily inside the existing auxiliary slot directly inside the Epson printer.

The stand-alone Microbuffer is installed in-line between virtually any computer and any printer.

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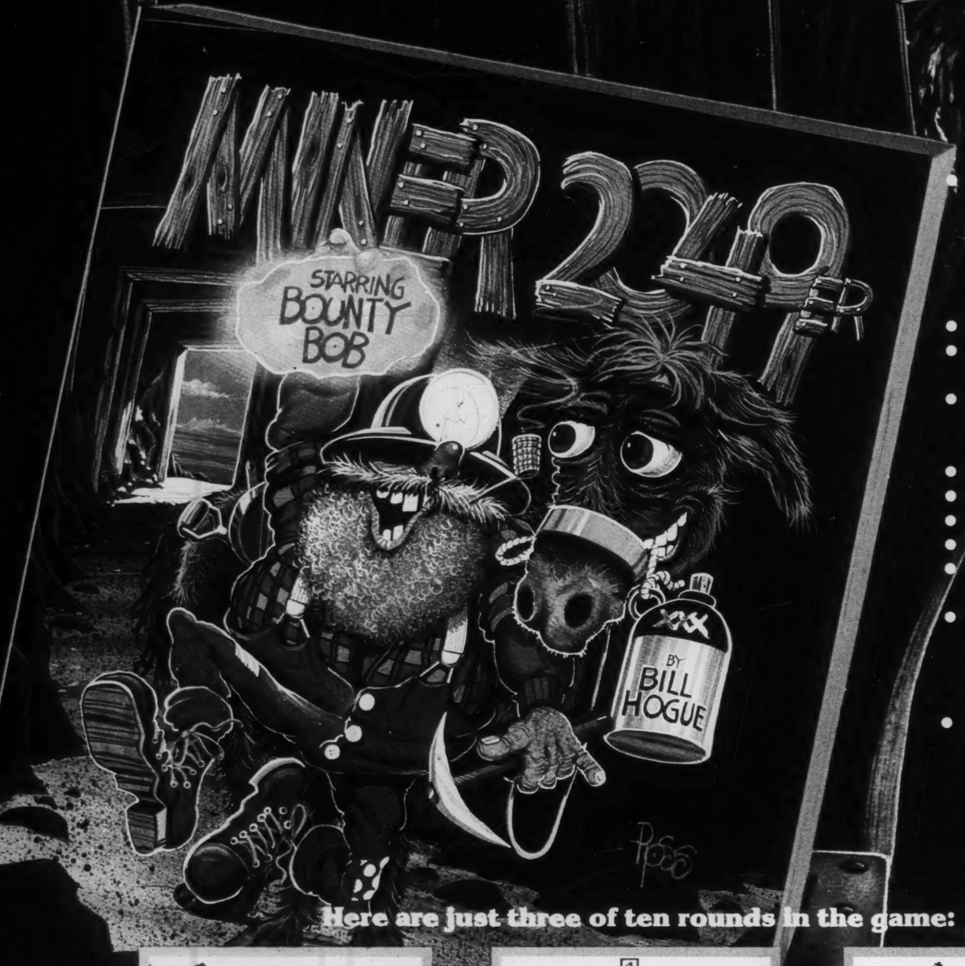

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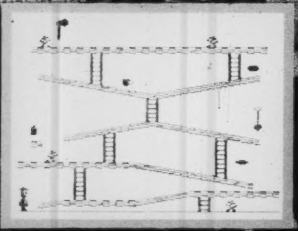
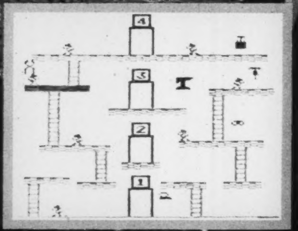
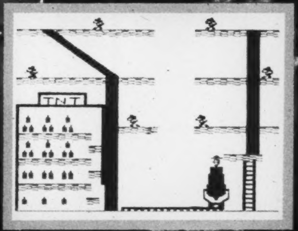


Round 1: The Mine Shaft.

Sharpen your miner's skill.



Round 3: The Transporters.



Round 10: The Cannon.

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in this issue...

evaluations & profiles

16 The Jupiter Ace .... *Helck*
A low cost computer that speaks Forth

22 CompuCorder .... *Stolker*
Speech storage and output for S-100 systems

33 Sound Software .... *Archibald*
Audex and Sight 'n Sound

43 Making Music With Your Vic .... *Goldstein*
Piper, Vic Music Composer and Synthesound

48 GEAP Dot Writer .... *Steur*
A character and font generator

64 The Graphic Solution .... *Anderson*
Bytes, camera, action for Apple graphics

76 Pursuit Of The Graf Spee .... *Murphy*
Warfare in the Atlantic

80 Newtrieve .... *Johnson*
Rapid random record retrieval

84 Quik-Vis .... *Ahl*
Apple VisiCalc with a joystick

87 The Transparent Sort .... *Ahl*
A demonstration of the Shell/Metzner sort

articles

63 Hello, My Name Is 420724-7091 .... *Mosey*

96 Saul Bernstein: Pixel Picasso .... *Anderson*
An interview with our cover artist

111 Computers Make Music .... *Smith*
What's happening in music synthesis

117 Translingo .... *Murken*
English-like musical notation

122 Variable Speech .... *Friedman*
Listen faster and learn more

130 A Layman's Guide to Disk Protection .... *Tubb*
Why it works and why it doesn't

250 The Metaphysical Exam .... *Payack*

July, 1983
Volume 9, Number 7

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applications & software

89 Lo-Res Sort Display .... *Schwaegler*
Watching algorithms in action

Improving TRS-80 Graphics

135 Medium-Res Plotting With A Line Printer .... *Rudeen*

142 Line Drawing Routines .... *Wagner & Wagner*

154 Lo-Res Fantasy Graphics .... *Foxx & Holforty*
Colorful abstract patterns for the Apple

161 Graphics Routines For The IBM PC .... *Gabrielson*

176 Expanded Monsters For The Vic .... *Luce & Wheeler*
Custom characters for the expanded Vic

188 Sound Tables .... *Adams*
Fast sound effects from Basic

196 The Well-Tempered Apple .... *Fink*
Tuning the Apple speaker

200 Computer Art For The Tektronix 4052 .... *Jacobson*
Wobbly spirals

202 Celestial Music Revisited .... *Perkins*
Modifications to Leo Christopherson's program

206 Animated Hi-Res Sailboat .... *Schug*
A sailing tutorial

222 Cavern Quest .... *Jaeger*
An adventure for the Vic-20 and Bally Arcade

departments

6 Input/Output .... *Readers*

10 Notices .... *Fee*

14 Dateline: tomorrow .... *Ahl*
News and views

226 New Products .... *Devlin*

238 Controller Corner .... *Riley & Riley*
A sketch pad for the Apple

252 Apple Cart .... *Anderson*
The IAC meets the IIe

260 Outpost: Atari .... *Anderson*
Electronic Arts and the Title Card Generator

276 Commodore's Port .... *Swank*
Monitoring the contents of Vic memory locations

282 IBM Images .... *Glinert-Cole*
The PC XT, utilities and more on the p-system

288 TRS-80 Strings .... *Gray*
Update on SuperScripsit

294 Book Reviews .... *Gray*

the cover

The British crown came to Silicon Valley for a visit dampened by rain, but not in spirit. Saul Bernstein created the computer image for the approval of the Royal Family using the Hewlett-Packard HP-2700. The story begins on page 96.

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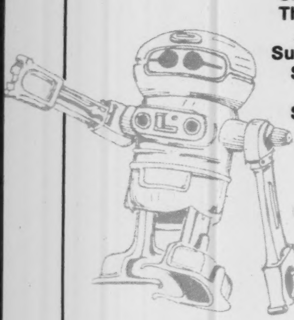

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tput...input/output...inpu

April Fool

Dear Editor:

I would like to comment on your April Fool's ads. I was writing down the address of the firm that made DELIZA II to tell them that it appears to be no better than a dull Eliza game I have played. Then I noticed the oddity of the address. It dawned on me that it was very obviously an April Fool's joke. This is not the first time I have been taken in by jokes like this. So I searched the issue for other such gag ads. I found the one about the surgically implanted computer to be a jeer at Barney Clark who recently died after 112 days of being a hybrid of man and machine. For his courage and endurance, he deserves better than being jeered at by your tasteless jokes.

Paul R. Wilson
19 Sunset Pl.
Bergenfield, NJ 07621

As writer of the ads, I would like first to say that I view Mr. Barney Clark as a modern hero—a man of intense personal courage. It hurts me to think that anyone would view the MicroManframe *ad as somehow intended to detract from him. It poked fun only at the computer industry.*

I should also point out that the lead time of Creative *is such that the ad was written* before *Mr. Clark underwent surgery.*

The Deliza *ad meant to point out the shallowness of "interpersonal" relationships with computers. The journal* Computers in Psychology and Psychiatry, *by the way, has requested reprint rights for the ad.—JJA*

Objectivity as Subject

Dear Editor:

Don Berry's guest editorial, "Experience, Experiments, and Intelligence" in the December, 1982 issue of *Creative Computing* was an absolute marvel of misunderstanding and inconsistency. I have seldom seen such an eloquently written expression of ignorance.

First of all, since the misstatement of physical theory has always been a pet peeve of mine, let me set Mr. Berry straight on quantum theory. Quantum wave equations say nothing at all about subjective versus objective reality. Yes, quantum theory says that there is an interaction between the observer and the observed—but any two observers running the same experiment will observe the same thing. The observer's opinion never enters into the experiment, i.e. it is not subjective.

Mr. Berry pooh-poohs the idea of using experiments rather than theory to determine the origin of human consciousness. In science, an idea is not called a theory unless it is testable. The only way to test a hypothesis is to run an experiment. Mr. Berry also apparently confuses "experience" with "experiment." Regardless of their origin, the second word describes an attempt to undergo a repeatable instance of the first.

Mr. Berry says that there has been a "Lack of true experimental investigation of the nature of consciousness." Is he blind? The amount of evidence supporting a biochemical foundation of intelligence is enormous! People who have had portions of their brains removed (by accident or surgery) show altered mental abilities. People who have other portions of their anatomy removed may be altered emotionally, but they still have all their mental faculties. Draw your own conclusions.

Mr. Berry states that "living languages" (called "natural languages" by most) are unusably vague. He misses the point altogether, though, when he claims that "thought," "consciousness,"and so on have more definite meanings in Sanskrit than in English. The "meaning" of something is separate from the language it is expressed in, so any language should be able to express it.

Mr. Berry seems to think that trying to match human abilities by more complex programming is a mistake. I don't agree. People are certainly more complicated than the programs we have written so far! I, for one, am not tired of all the talk about Artificial Intelligence, except perhaps the talk of what computers can never do. Let's just wait and see, shall we?

Ron Lunde
1210 W. Dayton St.
Madison, WI 53706

Score 1 for the 64

Dear Editor:

I have implemented the "Large Factorials" program by Donald Piele in the March issue on my Commodore 64. I decided to check the results against the factorial tables of the *CRC Standard Mathematical Tables*, 25th Edition, 1978. The values are given for exact results up to 30! You can imagine my surprise when I found CRC to be wrong, starting with 22! The Commodore 64 agreed with CRC up to 21! and then diverged, but hand calculations of 22!, 23!, and 24! all agreed with the computer output. In addition, the result for 52! and the computer agreed for the value of 52! given on page 180.

I have written CRC and am interested to see their response. I have also modified the program to give other large numbers exactly, such as Mersenne primes (607 is such a generator, and 2^{607} - 1 is a prime number of 183 digits) and perfect numbers. This last step required the ability to multiply some large numbers and a generalization of Piele's routine. Thank you for the article and I hope this anomaly amuses you as it did me.

Vincent J. Mooney Jr.
607 Wyngate Dr.
Frederick, MD 21701

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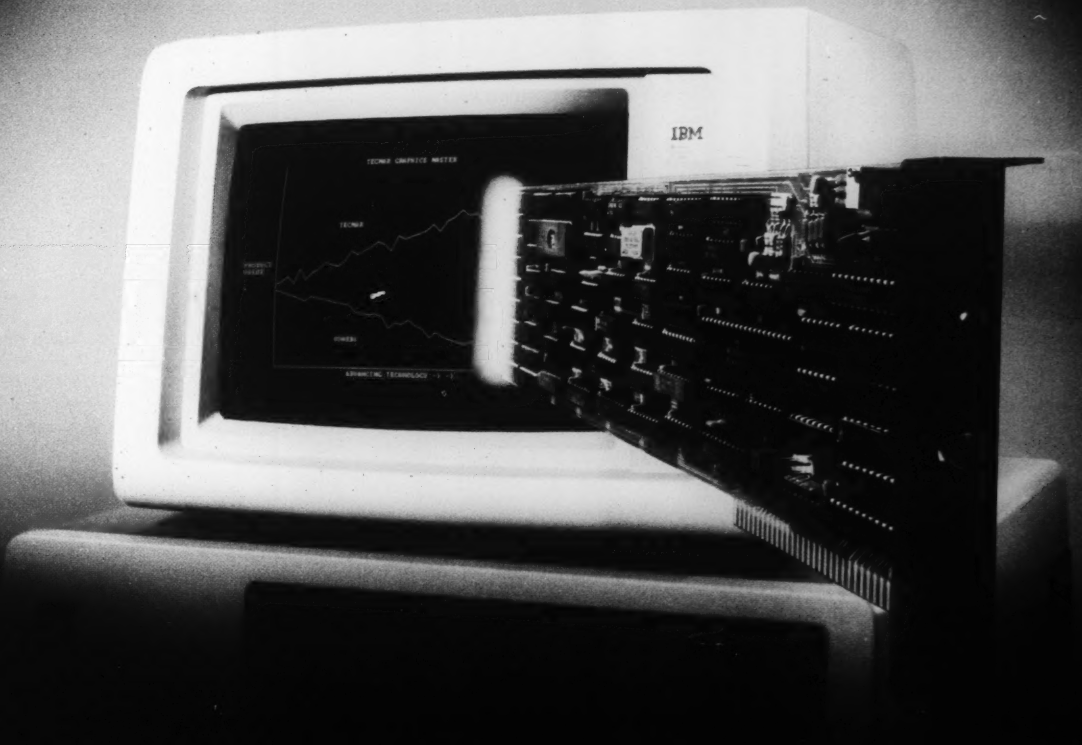

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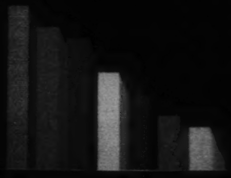

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tput...input/output...inpu

Homeless Accountant

Dear Editor:

We read with interest your review of *The Accountant* in your February issue. Unfortunately, your reference to "Home Accountant" on the cover may have confused some readers.

For the record, the program you reviewed is *not The Home Accountant*, the world's most popular home finance program, according to several independent tabulations. *The Home Accountant* is published by Continental Software for Apple II/IIe, IBM PC, TRS-80 Model III, Osborne 1, Commodore 64, Atari 400/800, and Texas Instruments Professional Computer systems.

Jim Sadlier
President
Continental Software
11223 S. Hindry Ave.
Los Angeles, CA 90045

3-DeBugging

Dear Editor:

I have found a couple of problems in your 3-D Plotting program. In the January issue the "Three Ways of Looking at a Function" program had save and display programs. I could not get either of them to work. The following corrections will remedy the situation:

In the save program, add a comma just before A$2000 in line 140. In the display program, add a new line 125 as shown below

Save PGM

```
 140 Print CHR$(4);"BSAVE";A$;",A$2000,L$1FFF"
```

Display PGM

```
 125 INPUT "NAME OF PICTURE";A$
```

Steve Rollins
4730 Elmhurst Ave.
Norfolk, VA 23513

Boot Loops

Dear Editor:

Donald Piele's article "Electronic Geoboard", in the May, 1983 issue was well written and especially valuable to novice programmers, such as myself. One small error should be called to the attention of your readers. Line 82 should be deleted since it prevents the for-next loop from operation.

Thomas Schneck

Zeroing In

Dear Editor:

Your review of *Donkey King* by Tom Mix Software is quite accurate. It is simply the finest arcade game I have ever seen for the Color Computer. As your reviewer suggests, though, this game is fairly difficult (which probably accounts for the length of time our family has continued to enjoy it).

Young children or arcade novices may be frustrated because they are unable to put their names and scores on the session "scorecard" at the end of play unless the score exceeds 11,000 points. This is because the game, when loaded, already includes names and scores from 11,000 to 20,000. To get the high score requires a very high score in excess of 20,000 points!

I have developed a Basic program which erases the names of the ten high scores that come with the game and sets the high score to zero. This allows for more keen competition between players of less than expert skill.

```
10 CLEAR200,10000
20 FORJ=31634TO31717STEP9
30 FORK=J TOJ+4:POKEK,32:NEXTK
40 POKEJ+6,0:POKEJ+7,0:NEXTJ
50 EXEC12803
```

This program should be keyed in or CLOADed after the *Donkey King* cassette is CLOADMed, but before it is EXECed. When run, the program makes the necessary modifications and executes the game program.

If line 50 is deleted, the program will make the needed modifications to the machine language game program, but it will not be executed. This allows for saving of a modified version by:

```
CSAVEM"NEWDONKY",12803,32513,12803
```

This modified version can be CLOADMed and EXECed in the normal manner. Each time it is loaded, the scores will be zeroed out. If you make a modified copy, duplicate only your OWN game; software piracy is just an unnecessarily polite term for STEALING.

Thanks for a fine magazine. I eagerly look forward to each issue and have learned a lot from *Creative Computing*.

Robert C. Lake
3206 Covered Bridge Rd.
Montgomery, AL 36116

Humbugs?

Dear Editor:

I found Mr. Spahitz's article "Rediscovering Level II" in the December issue very interesting but I would like to point out one possible problem. The "flip flopping device inside the keyboard that controls cassette input/output" is the relay that controls the cassette motor start/stop. This particular relay has been known to have a fairly high failure rate and I, personally, would not recommend putting undue stress on it for making "hums, buzzes, and clicks." This may seem a trivial matter, but for the non-technical user who may have to have a relay replaced in the shop, it is a needless waste of money and downtime!

Sound output from the Model I can be achieved with no hardware modification and minimal software. The method is to lengthy to go into in this letter, however, if any readers are interested they can contact me at the address shown below. Please include a SASE.

Richard W. Elliott
#901, 820 5th Avenue S.W.
Calgary, Alberta T2P 0N4
Canada

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National Conference On Artificial Intelligence

"Is my opponent a human or a machine?" Chess players will be asking themselves this question as participants in the Fredkin Chess Prize Competition, part of the National Conference on Artificial Intelligence (AAAI-83) to be held at the Washington Hilton Hotel in Washington, D.C., August 22 to 26, 1983.

A two-day tutorial program, August 22-23, aimed at a technical and business audience, will precede the conference.

Industrial computer software and hardware of interest to the intelligence research community, along with leading books and journals will be on display at the AAAI-83 Research and Development exhibit program August 22-26, 1983.

For information, contact Claudia Mazzetti, AAAI, 445 Burgess Dr., Menlo Park, CA 94025. (415) 328-3123.

Health Education Competition

The Association for the Advancement of Health Education is sponsoring a Health Education Software Competition. Entries should be original pieces designed for educational use in schools, homes, hospitals, voluntary and public health organizations, clinics, and industry. All entries should use the capabilities of the microcomputer. There will be a $1500 cash award for the best entry; two $500 awards for second place, and five $100 third place awards. Entries must be received by November 1, 1983.

AAHE is an association of the American Alliance of Health, Physical Education, Recreation, and Dance and all winning entries will become property of AAHPERD, with royalties being paid to the authors.

For more information and an application packet, contact the Association for the Advancement of Health Education, Computer Software Contest, 1900 Association Dr., Reston, VA 22091.

PC '83

PC '83, an International Conference and Exposition featuring IBM Personal Computers and Compatibles, will be held Saturday through Monday October 8-10 (Columbus Day Weekend), 1983 at Boston's Bayside Exposition Center. The show hours are 10:30 a.m. to 5:30 p.m. daily. Ticket prices are $48 for a three-day exhibits and conference badge or $8 for a one-day exhibits only badge.

For more information, call or write Northeast Expositions, 822 Boylston St., Chestnut Hill, MA 02167. (617) 739-2000 or (800) 841-7000.

Correction

As a result of the feature in the *Buyer's Guide to Personal Computers*, entitled "Telecommunications for Atari Users," the authors, David and Sandy Small have been inundated with mail requests for information about the Microconnection and *TSMART*.

The Microperipheral corporation, manufacturer of the products, asks that all requests for information be sent to them at 2565 152nd Ave. N.E., Redmond, WA 98052. (206) 881-7544.

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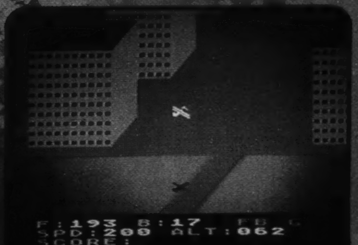
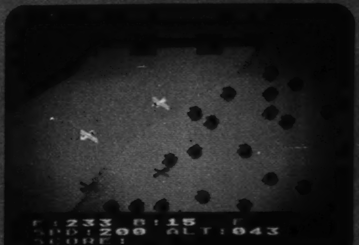


```
F:193 B:17  FB
SPD:200 ALT:062
SCORE:
```



```
F:233 B:15  F
SPD:200 ALT:043
SCORE:
```

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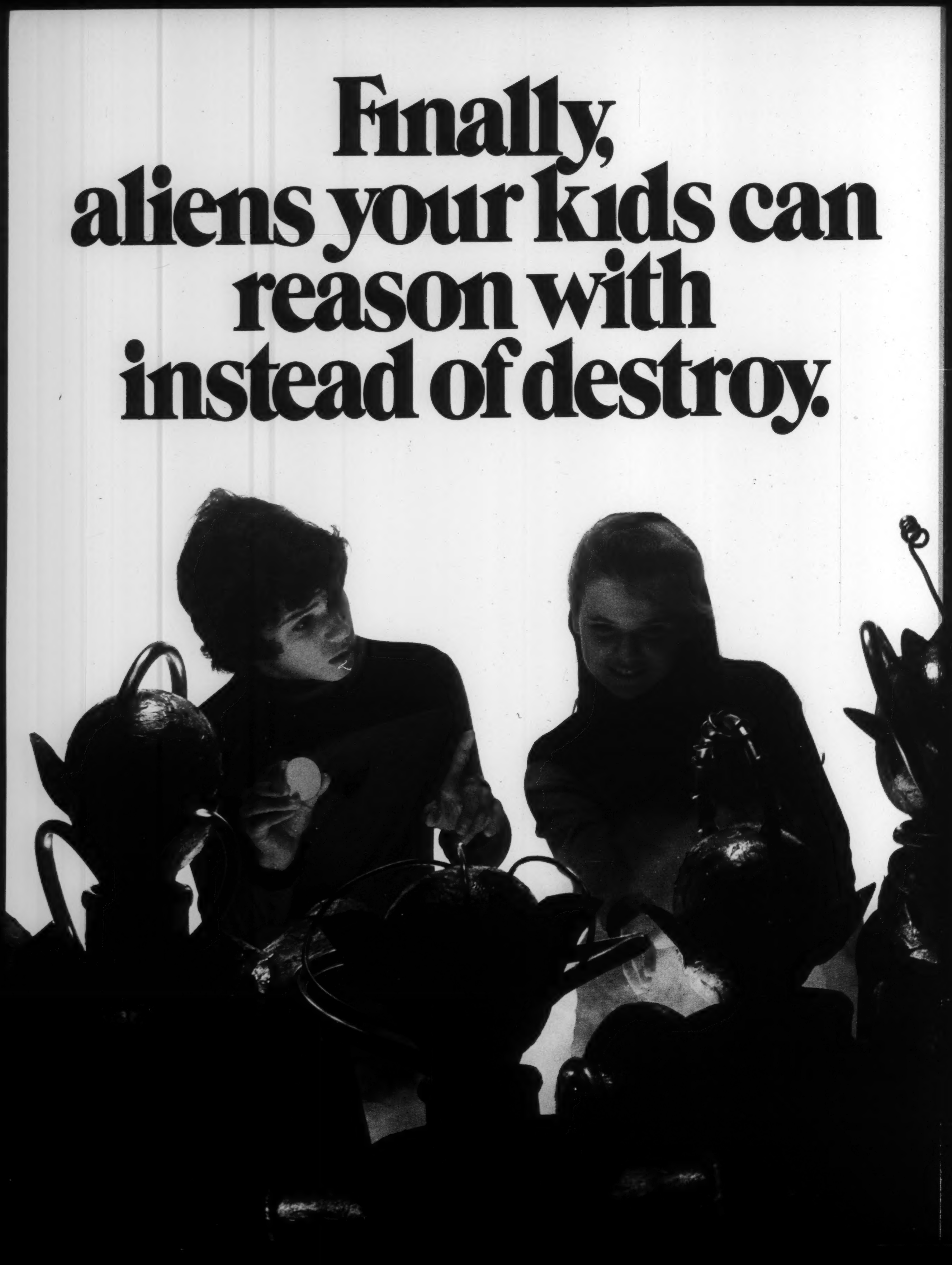
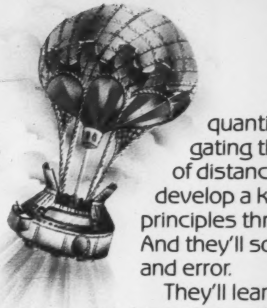

Finally, aliens your kids can reason with instead of destroy.



This year, thousands of kids will be searching for the most amazing thing.

At Spinnaker, we don't believe in the "kill or be killed" concept behind most computer games. In fact, we believe computer games should be instructive. Not destructive. But just as importantly, they should be fun.

That's why IN SEARCH OF THE MOST AMAZING THING™ is designed to let your kids negotiate with aliens instead of destroying them. Because given the opportunity, kids enjoy using their minds.

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The Most Amazing Thing is out there somewhere. Finding it won't be easy.

But relax, your kids will have the help of their old uncle Smoke Bailey. He'll give them a B-liner (sort of a cross between a hot air balloon and a dune buggy) to use on their journey. They'll have to learn how to fly the B-liner and navigate it through storms and fog. But before they do anything, your kids will have to talk to Old Smoke. He'll tell them about the Mire People and the strange language that they speak. He'll also tell them to avoid the dangerous Mire Crabs and how to get fuel for the B-liner.

Your kids will visit the Metallican Auction where they'll trade with the aliens for valuable chips. Your kids will then use these chips to buy things they'll need for their trip. And your kids will learn how to fly over the planet using their jet pack.

The Most Amazing Thing holds great powers, but it will take great skill, persistence and imagination to find it.

It's Amazingly Educational.

IN SEARCH OF THE MOST AMAZING THING is written by Tom Snyder, educator and author of the best-selling Snooper Troops™ Detective Series.

And like all Spinnaker games, IN SEARCH OF THE MOST AMAZING THING has real educational value. For instance, your kids will sharpen their ability to estimate distances and quantities. And since they'll be navigating their B-liner, they'll become aware of distance, direction and time. They'll also develop a knack for economic and monetary principles through trading with the aliens. And they'll solve problems through trial and error.

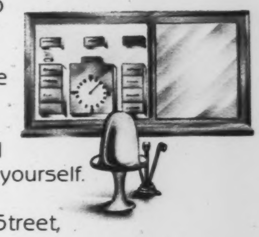
They'll learn all of these things, plus they'll learn that nothing is impossible if you put your mind to it.

A Novel Approach to Computer Games.

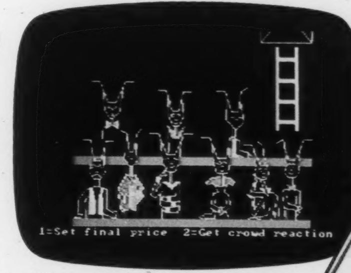
Besides offering your children all of the above, IN SEARCH OF THE MOST AMAZING THING gives them an opportunity to develop their reading skills. Because included with the game is Jim Morrow's new novel The Adventures of Smoke Bailey.* So your children will have hours of fun reading the book or playing the game. And they'll be learning at the same time.

Parental Discretion Advised.

If you're a parent who would rather see your kids reason with aliens than destroy them, you've got plenty of reasons to ask your local software retailer for IN SEARCH OF THE MOST AMAZING THING. It's compatible with Apple,® IBM,® Atari,® and Commodore 64™ computers. And it offers so much fun you'll probably be tempted to play it yourself. Or you can write us directly at:
Spinnaker Software, 215 First Street,
Cambridge, MA 02142.



You'll find this is one computer game that won't alienate you from your children.



```
1=Set final price   2=Get crowd reaction
```

IN SEARCH OF THE MOST AMAZING THING
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ow...dateline:tomorrow...dat

David H. Ahl

Watch for WarGames at a Theater Near You

WarGames is a wonderful new movie--good, solid adventure balanced by warm, human feeling. It will have you biting your nails one minute and laughing the next. It has the most real entertainment packed into 90 minutes that I've seen for a long time.

Briefly, a teenager, David Lightman, uses his home computer (an IMSAI!) to tap into a Dept. of Defense war game that turns out to be more real than game. You might want to watch near the beginning when David is leafing through a magazine at home--I'll send $5 to the first person who writes and identifies which issue of Creative Computing it is.

Playing Games by Telephone? It's Here Today.

Control Video announced the first interactive telecommunications service linking Atari Video Computer Systems (VCS) and compatible systems with mainframe computers for downloading games. To use the service, called GameLine, a master module (essentially a high-speed modem) is plugged into the VCS cartridge slot, and you dial the GameLine computer.

The master module costs around $50, membership is $15, and each game loaded costs about 10 cents or $1.00 for an hour of play. For the first 10,000 people who sign up (for $49.95), Control Video is throwing in $25 worth of play time and waiving the membership fee.

For more info write William vonMeister, Control Video, 8620 Westwood Center Drive, Vienna, VA 22180.

Street Price Index

Starting next month, Creative Computing will run a new monthly column called the "Street Price Index." Similar to the stock market tables in the daily paper, the index will show the list price for most major computers and peripherals, as well as the high and low price seen that month.

Some price movement this month was seen on many popular makes. The Timex 1000 dropped to $39 in many areas and as low as $29 from some dealers trying to unload stocks in anticipation of the Model 1500 (a 1000 with 16K of on-board memory) and the 2000 (similar to the Sinclair Spectrum).

TI dropped plans to market the low end 99/2. Instead, they lowered the price of the 99/4A to $99 in two steps--$149 in the spring, and $99 starting in June. TI claims to be selling 30,000 units per week at the $149 price level.

Atari instituted a $50 rebate on the 400, generally thought to be a move to get rid of existing stocks in preparation for the introduction of an upgraded machine. Depending upon how you look at the $70 free software offer also still in effect, the street price on the 400 is as low as $79 in places, although $99 to $139 is more the norm. In any case, it is a great deal!

Astonishingly, we have already seen the Apple IIe and Atari 1200XL heavily discounted. The IIe with 128K and 80-col board is going for $1345 in many places and we saw a 64K 1200XL priced at $569 (after a $100 rebate).

We weren't surprised to see the official 20% price cut on the Apple III. List now on the 128K unit is $2495 and on the 256K unit, $2695. Even so, the systems seem glued to dealer shelves.

With Epson's announcement of a new printer, MX-80 prices have plummeted; $369 is not uncommon. This, of course, puts the pressure on other comparable units. The Okidata 82A is going for about the same ($370-$390), the Star Gemini 10 for as low as $339, and the NEC 8023 for $435.

Notes from the Far East

Here are a few tidbits I picked up while on a recent trip to the Orient.

Hong Kong: Robert Roberts, president of Texas Industries met with a group of stock brokers and businessmen for lunch. They were presented with the usual package describing the company with one difference--the financial data was on a floppy disk in VisiCalc for the Apple. Some of the attendees were a mite surprised!

Heard on the street in Hong Kong: IBM will have their personal computer manufactured by Tatung in Taiwan.

Singapore: Tandon is relying more and more heavily on part time housewives at their factory for such jobs as touching up PC boards, packing, and making disk drive subassemblies. A person working 20 hours per week would earn about $70/month. Obviously 88 cents per hour would have little appeal here but for part time work in Singapore, it's not bad.

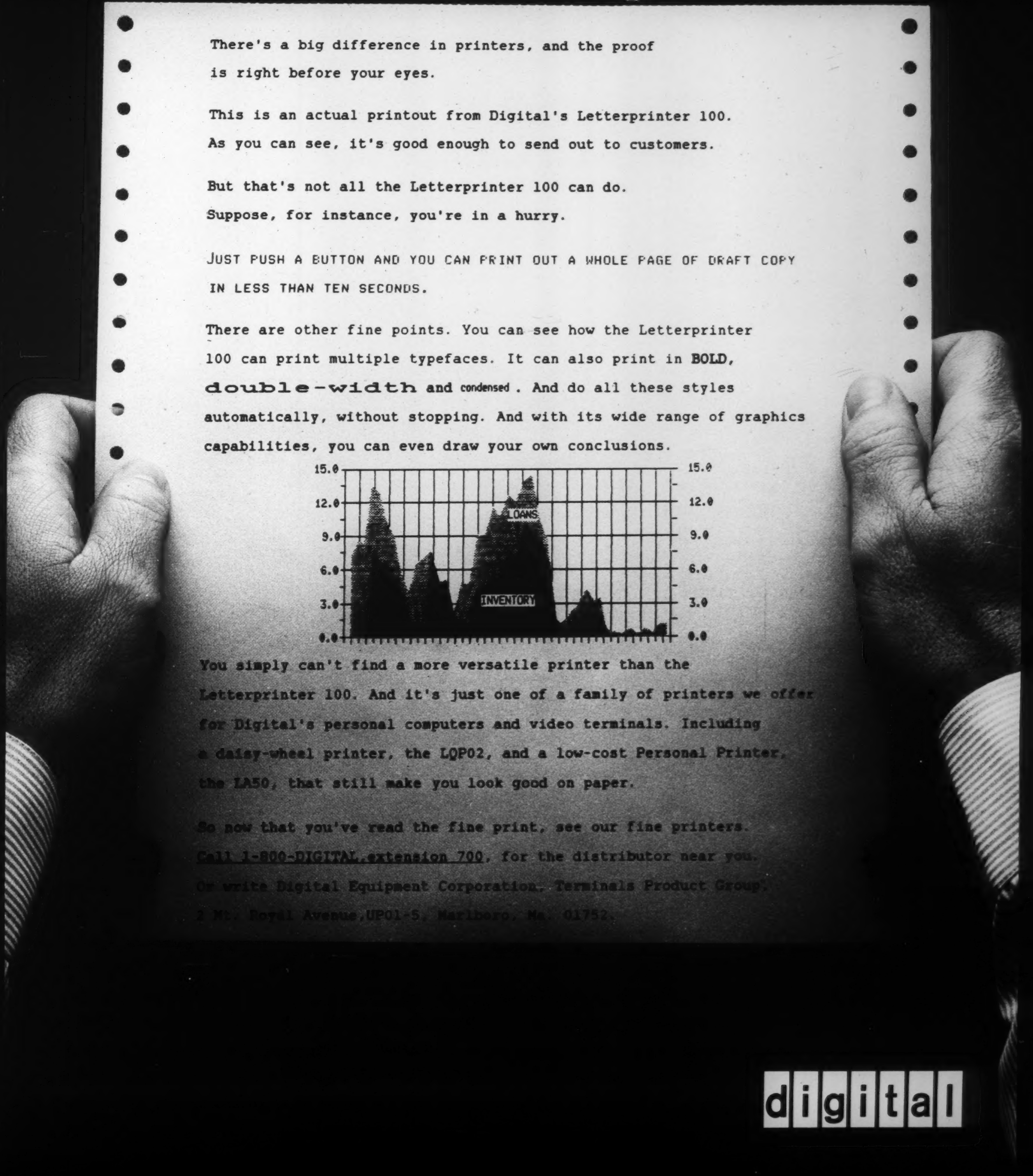
Headline in a paper in Thailand proclaimed, "National Workshop on Computers Agrees: The Computer Era is Here!" What a surprise.

When is a Mouse a House?

The usually accurate Wall Street Journal in an article about the MacIntosh, the low-end Lisa-like computer from Apple, reported that "it uses a house, or hand-held controller. A house is also a feature of the $9,995 Lisa computer."

A house once is a typo. Twice is a major blunder. Or do they know something we don't?

Speaking of the mouse controller, at least one manufacturer of them refers to more than one as mouses. Editor Staples prefers mice. Perhaps it is time to reinstate our Effective Writing column again. Any opinions out there?



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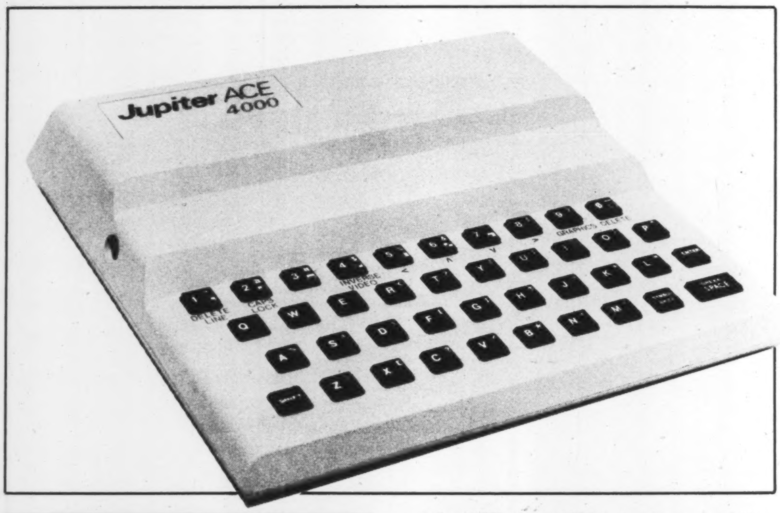
digital

The Jupiter Ace: A Forth Computer

Christopher Helck

No matter how you look at it, the Jupiter Ace, manufactured by Jupiter Contab Limited, is a small machine. Measuring 8½" by 7½" by 1½", it is slightly larger than the Timex Sinclair. The price is also small. The machine is available by mail order for $150 from Computer Distribution Associates of Oxford, PA.

The most interesting thing about the Ace is that it comes with the Forth programming language in ROM. This means that when you turn the machine on, Forth, not Basic, is running. Because there is not much software currently available to run on this machine, those who buy it are buying an opportunity to learn to program in Forth, one of the up and coming microcomputer languages. A selection of games and programming tools is promised in the near future should you yearn for other diversions once Forth is mastered.



The Keyboard

Almost half of the surface of the Jupiter Ace is covered by its keyboard. The keyboard consists of sculpted rubber keys under which lies a flat keyboard. It is much easier to type on than the flat plastic membrane on the Timex and the Atari 400. That is not to say that it rivals the keyboard of a typewriter—the keys rock a little bit while you are typing.

The space bar has become just another small key beneath the enter key, and a special symbol shift key is used to access punctuation. Overall, the keyboard has a nice feel, although those accustomed to full-sized keyboards will find it a bit cramped.

The computer itself is housed in a stylish white plastic case with red racing stripes and is a breeze to set up. It comes with an American plug adapter, a video cable with an RF modulator and two lines for hook-up to a cassette recorder. An ON/OFF switch would be a welcome addition. At the present time, to shut the machine off you must pull the plug.

The Ace is built around a Z80 microprocessor. It comes with 8K of ROM and 3K of RAM, expandable to 53K. The manufacturer promises to make 16K and 48K memory expansion modules available soon for $50 and $125 respectively. There are two card slots on the back. One is the Z80 pinout and the other is an edge connector that will support the memory expansion packs and an RS-232C interface when they become available.

The Ace is designed to be hooked up to a cassette recorder. A printer can also be added. The writers of the manual seem to be encouraging adventurous hardware designers to let their imaginations run wild and build exciting new peripherals. There is an example in the manual of how to hook up a traffic light controller. A built-in speaker allows beeps and even musical tones to be played.

Christopher J. Helck, Children's Computer Workshop, 1 Lincoln Plaza, New York, NY 10023.

GWENDOLYN.

THERE ARE SOME THINGS YOU KEEP SEARCHING FOR, BEYOND REASON.

Kidnapped in revenge and locked in hatred somewhere deep beneath your castle, is your princess.

Gwendolyn.

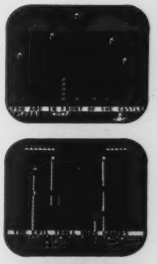
The prosperity of your kingdom, the end of a bitter feud, your very future depend on finding her.

You swear that no obstacle can stop you. But the high-resolution, 3-D graphics, animation and sound effects make the obstacles that await you more formidable than you can imagine.

And with over ninety different screens and two full sides of play, those obstacles and the decisions you must make can appear endless. In fact, you may have to endure hours of searching to rescue Gwendolyn.

But for her, you would endure anything, wouldn't you?

Gwendolyn—a non-violent, intermediate graphic adventure game, written by Marc Russell Benioff, Atari 40K Disk $27.95, Artworx Software Co., Inc., 150 N. Main St., Fairport, N.Y. 14450. For a free catalog of Artworx Software for the Atari, Apple, VIC-20 & Commodore 64 computers, write or call 800-828-6573.



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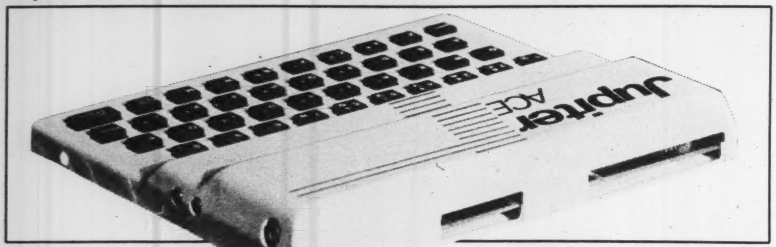

The rear view reveals the Z80 pinout and an edge card connector.

Forth And The Jupiter Ace

Forth is an interpretive language which is gaining popularity. At its best, Forth is fast and compact; at its worst, it is unreadable. For numerical calculations, it uses reverse Polish notation—to add 3 to 2 enter

3 2 +

rather than the more logical

3 + 2.

Instead of writing programs as in Basic, what you do on the Jupiter Ace is to write words in Forth. These words may then be used in other Forth words. For instance, once a square root function has been defined, it may be used anywhere, anytime, either in another word or interactively. As each word is defined in Forth, it is appended to the dictionary.

The Forth that comes with the Ace is a subset of Forth 79. The power of this small subset is a tribute to the strength of Forth. With the words included, an enterprising programmer could write a version of Basic if he so chose.

One or two additions to the standard vocabulary are worth mentioning. The Ace allows you to inspect and modify old words that have gotten buried within the dictionary without disturbing the words on top. In standard Forth, you would have to recompile the dictionary all over again.

The words IN and OUT are of potential interest to people like myself, who are intimidated by hardware and yet feel they should know something about it. IN and OUT allow you to read and write the input and output ports of the Z80. I haven't had the nerve to connect anything to the 80 pinout yet, but I am far more likely to do that than I would be to attach something to my IBM PC. Maybe I would even learn something.

The Ace version of Forth has its limitations as well as its advantages. The most important is that there are fewer than 1000 bytes of usable space to work with in the 3K version. This is not enough to write even a bad version of Pac-Man. In addition, the compiler is rather severe; it tends to wipe out the system when it runs into trouble. The main problem, however, seems to be in the user interface. After you type a line and hit ENTER, the computer tries to interpret the entire line, including the garbage to the right of the cursor (which is there because you did not bother to erase it when you backspaced) as a command. I found this very frustrating. On the other hand, the Ace does include a fairly nice line editor, and if you use it correctly, you won't have any garbage to the right of the cursor.

Related to this problem is the question, "Where is the input line?" When the machine is brought up, the input line is at the bottom of the screen, which is where we come to expect it. However, certain commands move the input line about on the screen, leaving chaos in their wake.

Graphics On The Ace

The display is black and white. There are two display modes: a character mode, which provides 23 lines of 32 characters, and a graphics mode, which provides 46 lines of 64 pixels. The character set is defined in RAM, and it is amusing to play with it.

The only graphic command that the Ace supports is a point plotting routine; there are no line drawing commands built in. You can key in a Forth word, DRAW, for drawing lines. This command is described in the manual, along with a detailed explanation of how it works.

Overall, the manual is well written. It has some of the best beginner's explanations of some of the more difficult Forth words that I have seen anywhere. Everything it explains, it explains well.

In conclusion, the Jupiter Ace is a nicely designed but limited computer that is appropriate for people who want to learn to program in Forth. It is nice to have a computer that does what it is supposed to do—even if what it does is limited. Small can sometimes be beautiful.

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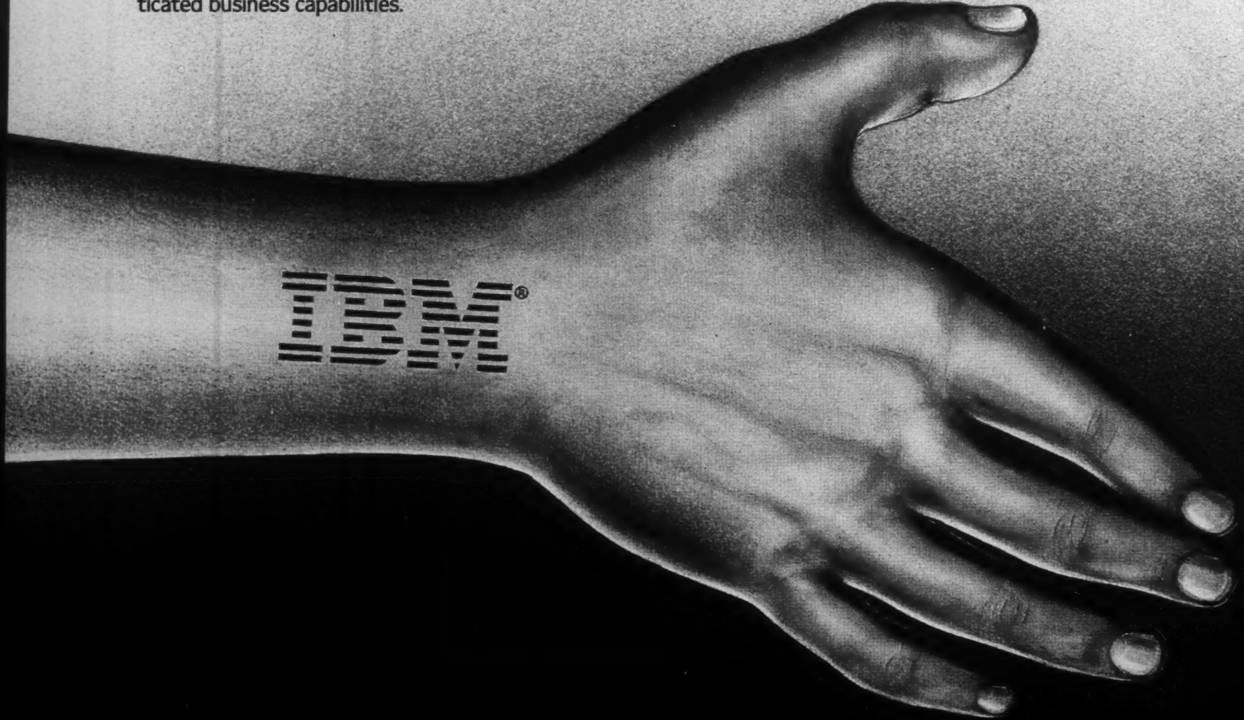

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CompuCorder Speech Storage And Output Device

Bud Stolker

When I first read the flyer announcing Computalker Consultants' newest product, CompuCorder, I thought back to that crisp winter evening in early 1979 when Oric, my Vector Graphic computer, spoke his first words. Installing the software had taken a month, and had exposed me for the first time to software patching and (shudder) assembly language.

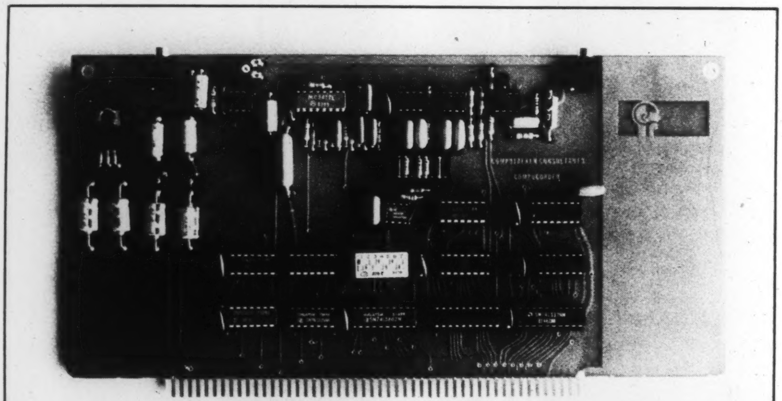
Daily I called the Computalker lab across the continent, reporting on the progress of the previous night, and asking for new equates to assemble, new bytes to poke. My speech synthesizer just wouldn't speak. Desperately I hoped that I hadn't thrown away money on a technology that I might never comprehend, and on a device that might never work.

CompuCorder is essentially a solid-state tape recorder.

I needn't have worried. Like the Heathkit people, Computalker Consultants wouldn't let me fail. My progress was slow at first, then quicker as I grasped how the software worked. I remember vividly my sense of wonder when the mysterious black box mounted on my new circuit board finally cleared its electronic throat and spoke. "How do I sound, Boss?" it said. It was more of a mumble than a crisp question, but I imagined that I understood. What a proud papa was I that night!

Technology has come a long way since synthetic speech first appeared in the microcomputer world in the mid 70's. The development of reliable, inexpensive circuit boards for voice output by Votrax and Computalker Consultants amounted to a genuine breakthrough in both price and performance.

The late 70's saw much of the hardware reduced in size from boards to



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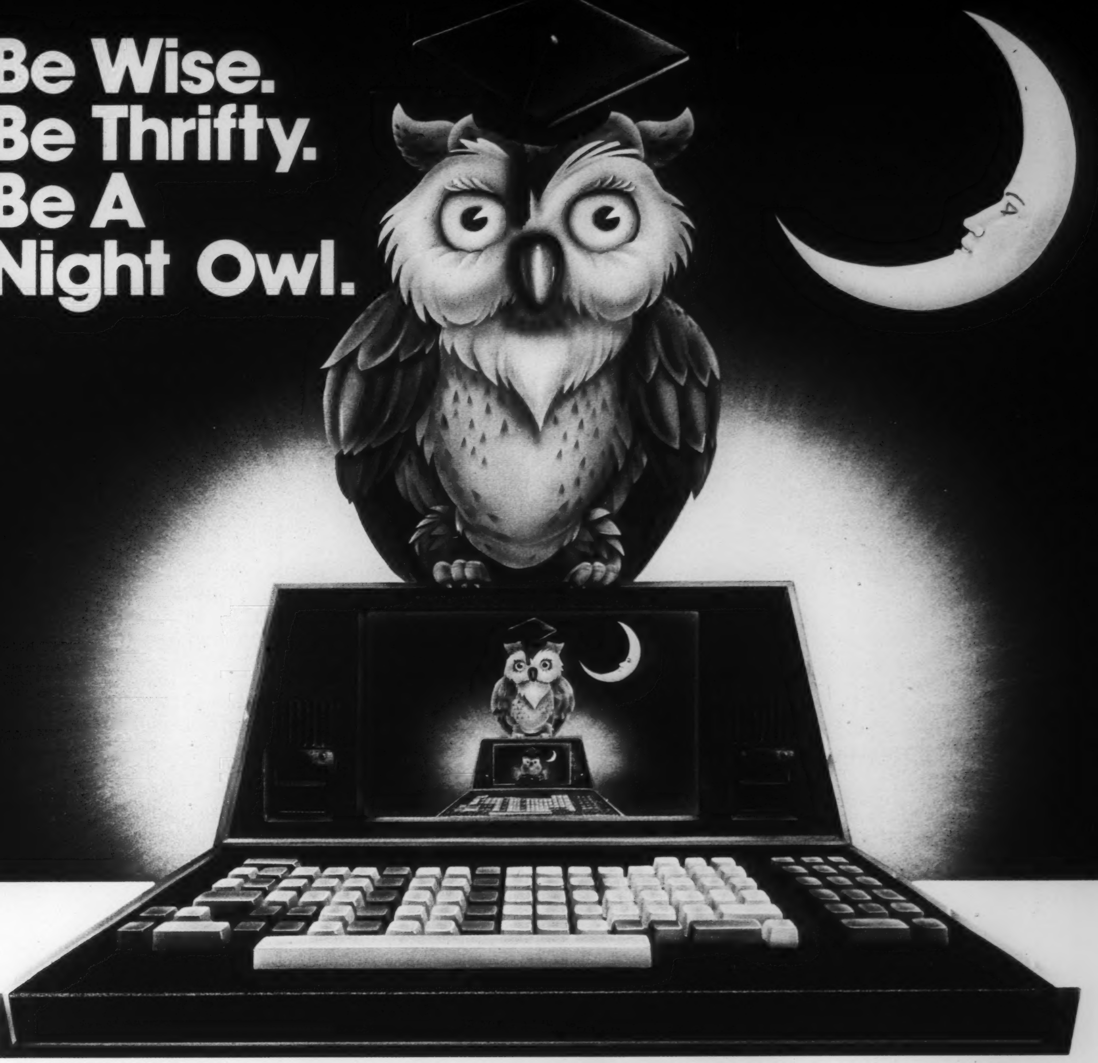

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Talks In Its Master's Voice

Now the makers of that original Computalker speech synthesizer [reviewed in *Creative Computing,* Sept.-Oct. 1978] have introduced CompuCorder, a new circuit that allows any S-100 computer to talk—or bellow or whisper—in its master's voice. The CompuCorder board, which retails for $295 plus $10 for CP/M-compatible driver software, can reproduce speech, as well as music and sound effects, with surprisingly high quality. By talking into a microphone, you can personalize the machine to speak in any voice, in any language, with any message. When Oric speaks now, he sounds just like The Boss. And once again I feel like a proud papa.

CompuCorder is essentially a solid-state tape recorder. It accepts sounds from a microphone or other audio input, stores them as data in random access memory (and on disk files if desired), and plays them back on demand through a conventional amplifier and speaker. The incoming sounds are converted to digital pulses by the on-board hardware, and stored in compressed format as individual bytes. For playback, the driver software sends the circuitry a byte at a time. The hardware converts the digital data back into analog waves which can then be amplified and sent to a speaker.

High-Fidelity Encoding Scheme

The encoding process, known as Continuously Variable Slope Detection (CVSD), enables high fidelity reproduction of speech or other sounds. The concept is simple but powerful. As a person talks into a microphone, the mike generates high frequency electrical waves that may be seen on an oscilloscope. The idealized version of one cycle of these waves is the classic sine wave: a gradual slope up to a peak, down again and through the baseline to a bottom point, then back up again.

The CVSD technique closely approximates the patterns of speech by continuously correcting the voltage output of the board to mimic the original waveforms. The signal produced on playback hugs the slope of the original wave, dropping a notch when the slope rises higher than it should, or boosting the signal when it starts to fall below the value of the original speech curve. Each instruction becomes either an "up" or a "down," or in a digital computer, a high bit or a low bit.

This technique can reproduce sounds with remarkable clarity, but at a price: it eats up lots of memory. At its highest bit rate (32 kilobits or 4K of memory per second), CompuCorder can only record 9.5 seconds of speech in a 48K CP/M system. And the speech files can be enormous. But in a computer with a 5mb hard disk, it is possible to record up to 20 minutes of continuous speech or 40 minutes with moderate frequency loss at the lowest (2K/second) data rate.

Other Methods Of Storing Speech

An alternative method of encoding speech is the one used by Texas Instruments in its Speak and Spell educational computer: linear predictive code (LPC). LPC-generated speech requires only a tenth as much memory as the CVSD method, but encoding the information in the first place requires a mainframe computer. In fact, LPC speech analysis on a microcomputer could require as much as a day's worth of computation per second of speech.

Voice recognition is, alas, impractical with the Compucorder.

"Big deal," you may be saying, "I can record and store speech in my Apple for 40 bucks, and I don't need any extra hardware." That's true; *The Voice* from Muse records speech through the cassette port and outputs it to the built-in Apple speaker. But the technique used is different, and fidelity loss is inevitable. *The Voice* simply counts the number of times the waveform swings across the baseline from positive to negative, and then POKES the Apple speaker once for each boundary crossing. This form of frequency modulation ignores most of the speech information and produces a characteristically harsh rasp.

The Voice and several similar programs make use of an ingenious and inexpensive way to make a computer talk and they don't require a great deal of memory to operate. But without specially tuned supporting hardware, they just can't produce high fidelity.

CompuCorder, on the other hand, can detect and reproduce the fine, often redundant details of a speech signal that give it an indefinably rich quality.

System Can't "Understand" Speech

Voice recognition is, alas, impractical with the CompuCorder, even though it is clearly listening as you speak into the microphone. The CVSD technique generates a very compact coding, which effectively disguises such things as the ends of words, so there is no way to tell how long the word "hello" is, for example. This makes it very difficult to analyze the waveforms using a standard approach.

"Current methods of doing continuous speech recognition require tens of thousands of dollars worth of equipment," says Ron Anderson of Computalker. "I don't expect to see continuous recognition of unlimited vocabulary before the year 2000. It will take years of research and small improvements. Maybe it will have to wait for new hardware, like 100 MHz processor chips. But don't look for any breakthroughs soon."

The Japanese are having some success with speech recognition, but that is to be expected, according to Anderson. "The Japanese language lends itself phonetically to speech recognition by computer. It has a very regular structure, with only about 60 different syllables, while English has hundreds, with much more complex patterns of connected consonants. With a precise language like theirs, the solutions are almost trivial." Well, almost.

Developed For The Military

But the development of CompuCorder was guided by the need to reproduce speech, rather than to understand it. It was developed for the military for use in a battle game simulator. A computer could, for example, select pre-recorded messages for broadcast by walkie-talkie in response to changing conditions on the simulated battlefield. And CompuCorder can mimic anyone from a four-star general to the lowliest grunt.

There are other military applications, too: computerized air traffic control systems, cockpit instrument panels that vocally warn pilots of potential problems, and sophisticated tutoring machines with foreign language vocabularies stored on disk, to name just a few.

These are situations which demand a device that can do more than a traditional phoneme synthesizer. Speech output can be used effectively when machine operators are already overloaded with visual information, as is the case in the complex control room of a nuclear power station. When a large number of messages must be heard and understood the first time, the job calls for a high capacity random access stored speech device. A CompuCorder-equipped computer with 64K of memory and a 5mb hard disk can do such jobs as well as systems costing three times as much.

Because the capabilities of CompuCorder are greatly extended when used with a hard disk system, the manufacturer is promoting this device as a board-level component suitable for OEMs (Original Equipment Manufac-

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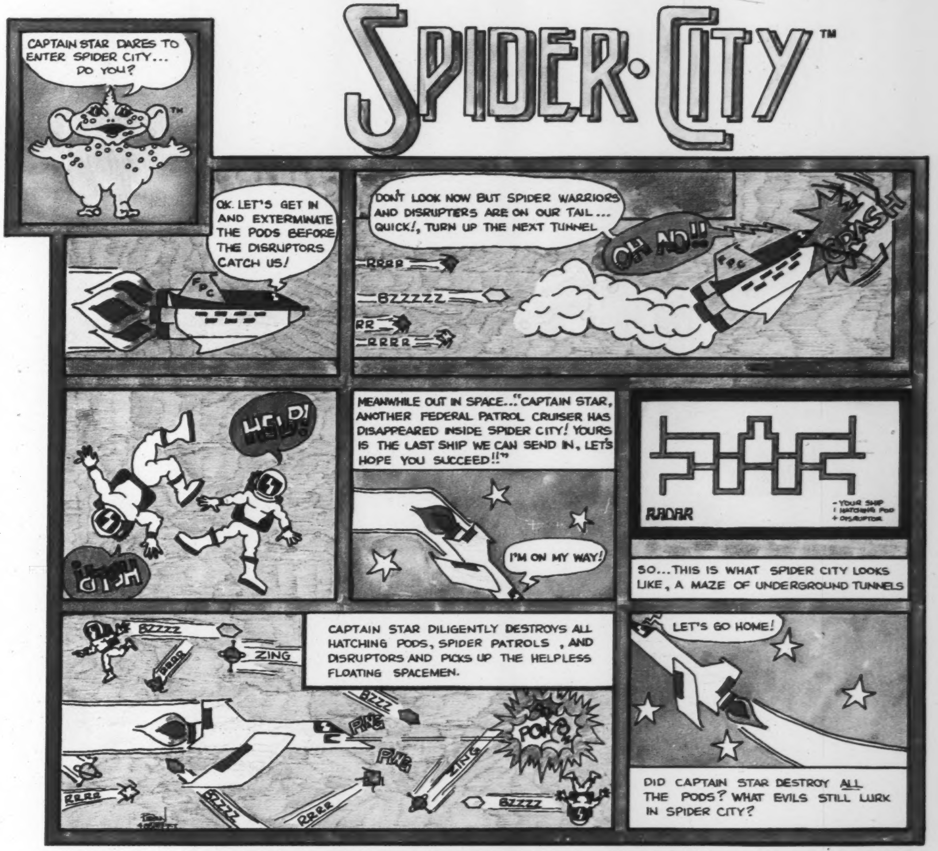
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RRRR
OH NO!!
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HELP!
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I'M ON MY WAY!
RADAR
- YOUR SHIP
I HATCHING POD
+ DISRUPTOR
SO...THIS IS WHAT SPIDER CITY LOOKS LIKE, A MAZE OF UNDERGROUND TUNNELS
BZZZZ
ZING
CAPTAIN STAR DILIGENTLY DESTROYS ALL HATCHING PODS, SPIDER PATROLS, AND DISRUPTORS AND PICKS UP THE HELPLESS FLOATING SPACEMEN.
BZZZ
PING
POW
PING
ZING
RRRR
BZZZZ
RRRR
BZZZZ
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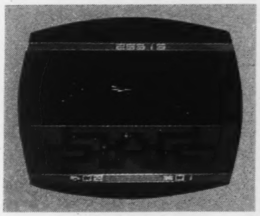

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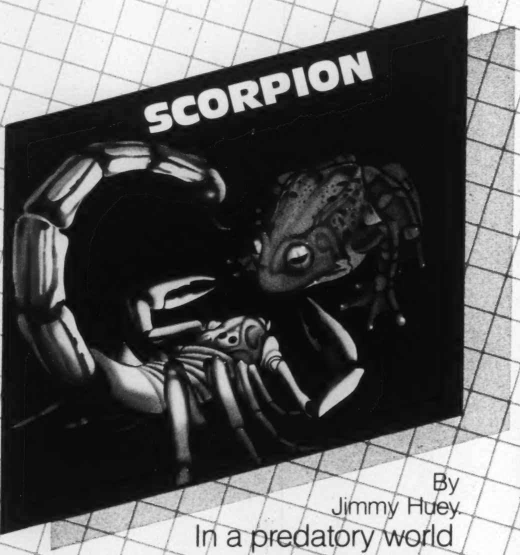

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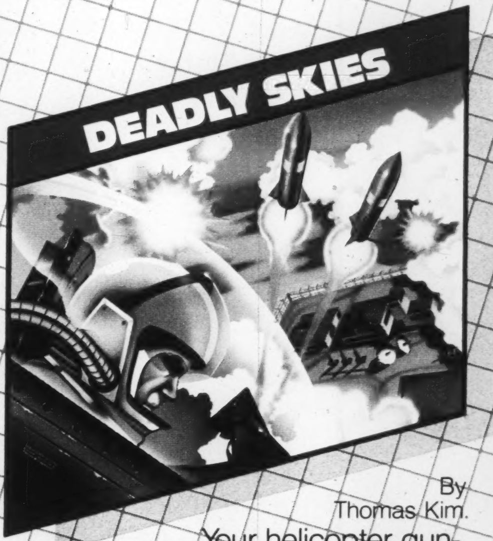

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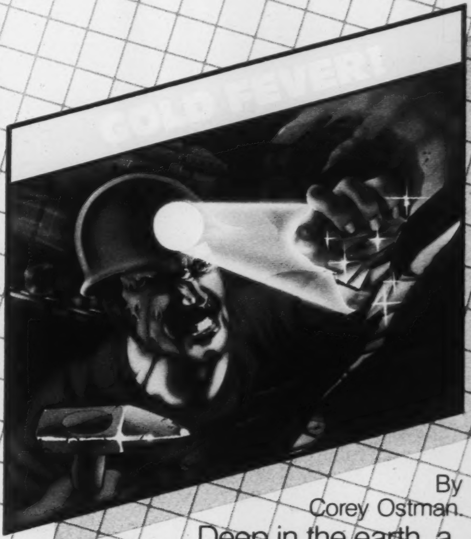

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turers). It is designed for folks who want to sell voice store-and-forward systems, paging systems, automatic announcing machines, and the like, where the presence of a high speed, high density disk drive is a given. But CompuCorder presents possibilities for the imaginative computer hobbyist with floppy disk drives as well.

A Singing Adventure Game?

Consider, for example, the radio amateur who wants an automatic repeater system. Or the hacker who wants to spice up his latest Adventure game with the creak of an opening door, the roar of an erupting volcano, or the siren song of a beautiful Lorelei. How about a really intelligent telephone answering machine, or a burglar alarm that can dial police and yell for help, or perhaps an alarm clock that sounds off with an appropriate reminder statement, selected from a repertoire of dozens—or hundreds—of messages?

All of these applications are possible with CompuCorder, but some will tax the computer—and its programmer—to the limit. The biggest problem is the enormous appetite of the device for memory. I have been working with CompuCorder for a month now, and have found it to perform adequately, given the constraints of my memory and disk capacity.

Variable Sampling Rate

The user must decide before he installs CompuCorder how much memory to allocate as a speech buffer. Four headers supplied with the system control the bit rate of the device, and therefore the fidelity and length of each message. Sample rates run from 10K to 32K bits per second. The higher the sample rate, the better the speech quality becomes, but the more memory must be dedicated as a speech buffer.

The 32K rate reproduces sounds clear as you could want; the 10K rate is barely intelligible. For applications involving the telephone you would use the next-to-lowest rate, 16K bps, since Ma Bell limits her bandwidth anyway. Even so, in my 48K system, I was able to squeeze out only 19 seconds per message at this bit rate.

The sampling rate is optimized for human speech, so don't get the impression that this is a poor man's digital sound studio. Really high fidelity music would require a higher bit rate. That could easily be achieved by changing a resistor or two on the removable headers, but again, as the sampling rate goes up, the length of the sound segment drops.

I would have preferred that the resistor headers be switch-selectable; instead, the user must remove the board from the computer and manually plug in the header of his choice. The assumption, I suppose, is that a user will stick with one bit rate for most of his applications.

Microphone And Amplifier Required

CompuCorder requires a quality amplifier to reproduce accurately the full range of the vocal tract. If the high frequency sibilants (sssss) don't come through, speech sounds a bit mushy. If the lows are cut off, speech sounds tinny. No amplifier is supplied with the system. This is not a major problem, though, since most people who have a computer probably have a high fidelity amp as well.

Two miniphone plugs on the board accept jacks for microphone input and amplifier output. Because the plugs are flush against the top of the board, I had a problem with cabling. My computer has a low-profile cabinet that would not close with cables connected to the CompuCorder. I went to the largest audio distributor in the city looking for right-angle miniphone plugs, but to no avail. When I am using the CompuCorder, therefore, I have to keep the lid of the computer open—an inelegant solution. I hope that on the next version of this board, Computalker Consultants will move the I/O plugs inboard.

CompuCorder requires a quality amplifier to reproduce accurately the full range of the vocal tract.

CompuCorder occupies two consecutive ports on the computer bus, one for status and the other for data. The board is set up initially to use ports AC and AD hex. A dip switch allows for changing the port assignments, but such a change also requires modifying the software slightly.

CP/M Software Supplied

While the well documented software supplied with CompuCorder is easy enough to use, it does require some working knowledge of assembly language. Although my assembly language skills have not significantly improved since I patched in my original Computalker software three years ago, I had no particular difficulties.

The software consists of five machine language programs written for the Intel 8080 microprocessor and will therefore work on Z80s and 8085s as well. Each is assembled for use with the CP/M operating system, but the author provided a way to move the code easily from one operating system to another.

The input/output routines are contained in "universal I/O modules" that can be inserted into the source code before assembly. Computalker makes available drop-in modules for close to a dozen popular 8080-based systems. This is a smart approach to software portability, and one which I hope will catch on. Not everyone has or wants CP/M! I prefer the North Star Disk Operating System to CP/M, and was able to convert the main demo program to be North Star-compatible without trouble.

The main demonstration program, Corder, operates like a tape recorder. By typing R, you can record a speech sample. Since the program automatically allocates memory, it will not crash the computer if you talk too long. If you want to say only a word or two, you can type D for Done. Typing a P will play back the speech as often as you like.

Two other demo programs, Record and Speak, store sounds in diskfiles and retrieve them. Because CP/M accepts concatenated commands, creating and saving a speech file is as simple as typing RECORD MESSAGE, then speaking into the microphone. To retrieve the speech, the command is SPEAK MESSAGE. Because the diskfiles are potentially quite long, there may be a significant delay between typing the command and having it processed. My single density Shugart drives take as long as 15 seconds to load the Speak program and the Message file it needs. A Winchester disk would speed up the process considerably.

Computalker also provides subroutines for recording and speaking that can be used with any programming language that can call a machine language subroutine. I had no particular difficulty linking these programs to Basic, but it did require reassembling the subroutines to an unused corner of memory. I also had to reserve some space for a speech data buffer. A 48K system with an operating system, Basic, CompuCorder driver software and a speech buffer doesn't leave much room for anything else, so the Basic programs I wrote were necessarily very limited.

Any serious executive program would have to be written in assembly language and shoehorned into whatever space was available. This may or may not be a serious flaw, depending on the application at hand and the skills of the programmer. Come to think of it, my Computalker speech synthesizer uses lots of memory also: 22K just for the

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For the Apple II/IIe

CIRCLE 141 ON READER SERVICE CARD

CompuCorder, continued...

driver software and speech buffer in its most "intelligent" mode.

System Human–Engineered

I found this board extremely easy to use. The software worked on the first try, and the microphone (which the user must supply) is a natural as an input device. More important, using a mike eliminates the need to generate words or phonemes (pieces of words) through the software. Gone is the awkward build-a-word approach that required the programmer to work double duty as a phonetician. Now all you have to do is talk.

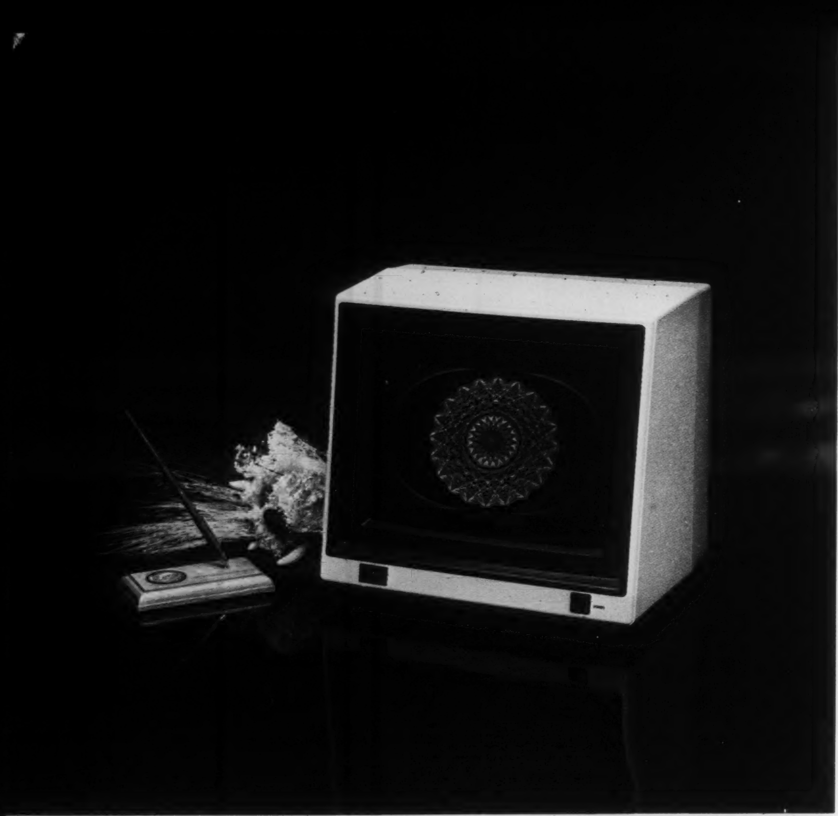
One problem with using a mike near the computer is the proximity of external, unwanted noise, both mechanical and electrical. The blower fan on the computer registered as white noise. My magnetic mike, sensitive to electrical fields, picked up hum near Oric's power transformer. A friend's condensor mike was less sensitive, but didn't sound as good. I achieved best results by crawling under the far end of the computer table, cupping my hand around the mike and my mouth to acoustically seal them, and speaking softly yet distinctly. It was hard to give keyboard commands that way, but the sound quality was worth it. Different types of microphones would no doubt require other recording techniques.

Using a mike eliminates the need to generate words or phonemes (pieces of words) through software.

In all, I am pleased with the performance of the board, and would not hesitate to recommend it to anyone who understands its limitations. Its full potential will not be realized unless you are willing to link it to a Winchester disk or perhaps a 5mb memory card. For some folks, that isn't a problem. For others like myself, well, we can just keep waiting for those prices to fall . . .

The Computalker people appear to be more interested in research and development than in marketing, so your local dealer may not be aware of this remarkable board. The Computalker staff will take direct product orders. I have found through experience that they support their customers after the sale with impressive expertise, courtesy, and prompt response. Their address is 1730 21st St., Santa Monica, CA 90404. (213) 828-6546. ☐

CIRCLE 401 ON READER SERVICE CARD



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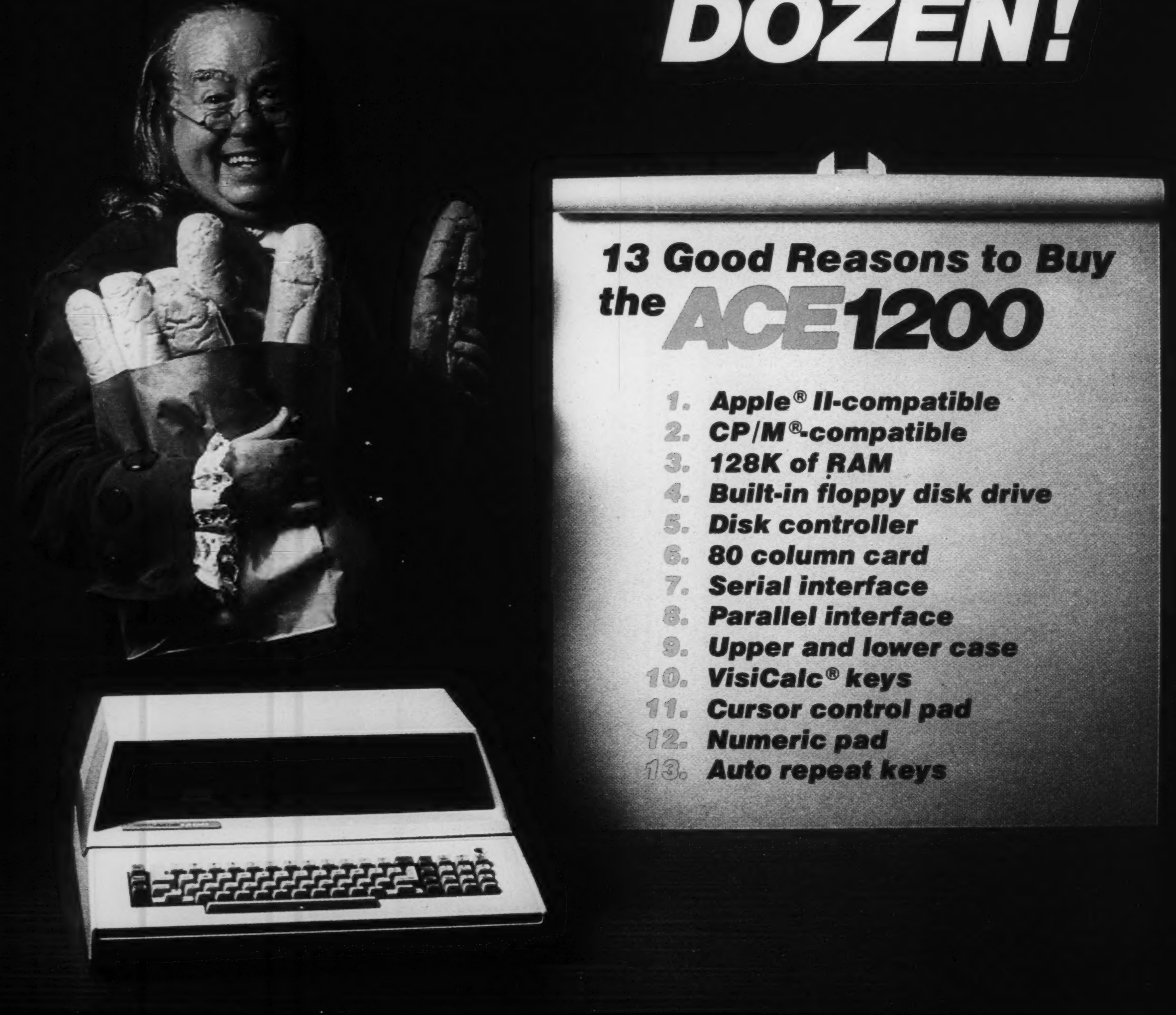

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CIRCLE 168 ON READER SERVICE CARD

Audex and Sight 'n Sound for the Apple

Sound Software

Dale Archibald

Audex

I have to admit, my previous exposure to sounds through the 2" Apple speaker has been limited. That is, I have heard guns go off, bombs explode, lasers zap, swords clang, that sort of thing. For the most part I have been on the receiving end, able to emit only a plaintive beep now and again.

Not any more. Friends, I have heard the light. That is, I have heard how *Audex* allows the Apple user to manipulate sound, and it is amazing.

I won't take any more backtalk from my Apple. Instead, I'll snip sounds here and there, take a tuck in a tenor, falsify a falsetto. I'll tape record a hammer and rapidly repeat it to sound like a machine gun, or stretch it and expand it until it's an artillery shell arriving.

Audex, by Pete Kosel, is furnished with a 65-page instruction booklet. The instructions are clear, concise, and well illustrated. In fact, this is a much better book than those which come with some much more expensive programs. Happily, the program is a good match for it.

Four Sections

There are four sections to the program, each based upon a complete tutorial approach in the booklet. First what a procedure does is described, then the user is taken step-by-step through the procedure. Help screens are abundant throughout.

Draw-A-Sound is the first program. It allows you to draw a sound pattern by individual sound pulse on the monitor screen, then save, transfer, modify, blend, and shape these patterns. In effect, this adds some of the options of a good graphics package to a sound program.

> ***You haven't lived until you have heard an Apple crooning part of "Lydia the Tattooed Lady."***

Part of Draw-A-Sound is Analysis/Adjustment. This lets you modify any part of entire segments of a pulse pattern. Using this, you can lower or increase pitch, increase or decrease pulse length, or make large or small differences in the contrast between pulses.

Excerpt-A-Sound, third utility on the disk, is my favorite. It allows you simply to record audio onto a tape recorder, then transfer it into the Apple through the cassette port. It excerpts that audio as a sound pulse, and lets you save it.

I'll admit, the sound is badly distorted, but you haven't lived until you have heard an Apple crooning part of "Lydia the Tattooed Lady" in Groucho's voice. ("She has eyes that folks adore so, and a torso, even more so.")

Next, Build-A-Sound can examine the individual files in detail, connect short patterns into longer ones as tables, and combine and edit pulses and tables.

Last, the Audio Opcodes give you a selection of six minor utilities. These let you mix all the sounds you have created

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SOFTWARE PROFILE

Name: Audex

Type: Sound effects generator

System: 48K Apple II

Format: Disk

Language: Assembly

Summary: Low-priced but amazingly complete

Price: $29.95

Manufacturer:
Sirius Software, Inc.
10364 Rockingham Dr.
Sacramento, CA 95827

Dale Archibald, 1817 Third Ave. N., Minneapolis, MN 55405.

with the above major utilities into your own programs.

Sound Ideas

As I understand the explanation of sound generation in the *Audex* instruction book, this program stores the length of time a sound wave crosses from zero to zero in increments of 50 microseconds (millionths of a second) from 50 to 12,750 microseconds. See Figure 1.

The digitized sounds are played back through the tiny Apple speaker or a separate amplifier as a series of clicks.

Digital recordings work more or less the same way, although with tremendous fidelity. For example, an audio engineer can re-record an old, scratchy record digitally, then set the equipment to remove all the frequencies that make up the scratches.

A digital tape recorder that costs over $150,000 slices each second of sound into 50,000 parts—20 times smaller than *Audex* can. Its fidelity, naturally, is much higher than that of the Apple. Nevertheless, the *Audex* can do what a digital recorder does, even if only on a small scale.

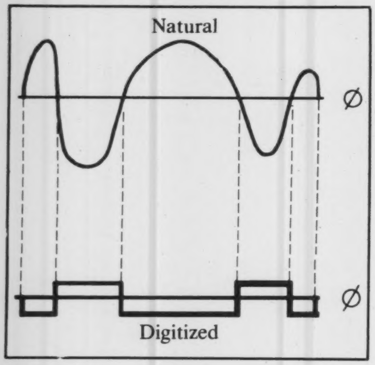


Figure 1.

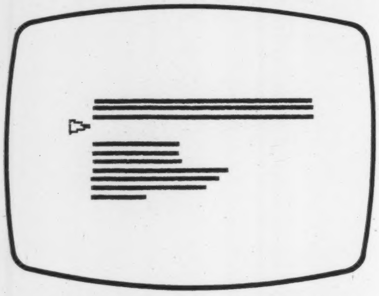
Pulses are the basic building blocks of *Audex*. A pulse is a delay of from 50 to 255*50 microseconds followed by a click.

In the *Audex* vocabulary, 255 of these pulses make a sound, 255 sounds can be in a soundset, and you can blend these onto a disk.

When you select the DRAW NEW SOUND or REDRAW A SOUND ALREADY DRAWN from the Draw-A-Sound menu, you can select from either of the above, save or load soundsets to tinker with, or move into other options.

If you decide to draw a new sound, on the left side of the screen will appear an arrowhead. This can be moved from pulse to pulse (and silence can be a pulse) by hitting N back with L. If you put it on autocursor, C, the arrowhead pointer will continue moving in the direction you select until you hit another key.

You can Enter a pulse by length from 1 to 255, or use the right and left arrow keys to adjust the length. When you use the autocursor and hit N, the arrowhead will continue to add pulses of the previous value until either you hit another key to stop it or it reaches pulse 255. In other words, should you enter a pulse of value 40 on autocursor, then hit N, the arrow will tick down the screen adding pulse after pulse of 40.



Audex pulses with cursor arrow.

At the bottom of the screen is a listing of which pulse the cursor is on, the sound number you are working on, and the value of the pulse designated. By hitting K you get a help screen.

One weakness of the program is that you can't just enter the pulse to which you want the arrowhead to move. You must use either L or N with the autocursor. Then you must wait while the cursor ticks its steady way up and down the screen. That can take a while for a sound of 255 pulses.

When you have finished "drawing" a sound, you can select the second part of the utility, Analysis/Adjustment. This lets you modify entire segments of the sound at one time. You select the range of pulses you want to adjust.

You can lengthen the average pulse and lower its pitch, or reduce the average and raise the pitch. You might adjust the percent of drift to set the shift of the pitch. (A long block of pulses set with a 100% drift could sound like a bomb dropping.)

Finally, the contrast adjustment contrasts each pulse with its neighbor; high contrast makes jagged pulse arrangements, while zero contrast looks and sounds smoother.

The lengthier the sound you are working upon, the longer it takes to change all the figures when you make an adjustment. After an adjustment is made, you are shown the chart of the sound. Hit H, and you hear what it sounds like.

You can save the sound to disk whenever you are ready, redraw sounds, hear the sounds you have already drawn, delete individual sounds from memory, even clear all sounds from memory. Each of the above is part of the Draw-A-Sound menu.

Excerpt-A-Sound

With the Excerpt-A-Sound utility, you can digitize tape recordings. Simply play them into the Apple cassette port, then select the segments you want to save. You can excerpt any selected portion you wish up to 255 pulses long. Later, you can edit these sounds on a pulse-by-pulse basis using the Draw-A-Sound utility.

Another neat trick is to attach a microphone to the tape recorder, then select Load Audio from Cassette from the Excerpt-A-Sound menu.

Hold the little tab on the upper left side of the cassette in while you press the record and play keys at the same time. With many cassette recorders, you will then be able to speak directly into the memory of the Apple. Note: the Heartape utility also allows you to do this.

Raw sound is organized into 28 segments of 256 bytes each, but only 128 bytes can be displayed at one time. By running through the segment in memory, you can pick the page in memory in which that segment is located.

Move to that page, and you can adjust the length of the sound you want to excerpt, up to 255 pulses. As an example, you might have a hammer pounding that you want to change into a machine gun through repetition, but you don't want the dog barking in the background.

> ***You might have a hammer pounding that you want to change into a machine gun through repetition.***

Looking at the pulses onscreen is rather like looking at seismograph printouts: even on the left, extending to the right. By moving your starting cursor to the beginning of the hammer bang, then adjusting the finishing cursor to the end, you exclude the unhappy pooch. As you are adjusting the pointers, you can hit H to hear what the sound is within them.

When satisfied, save that soundset to disk.

Build-A-Sound

Build-A-Sound lets you connect the sounds you have digitized into a Jabber table, then combine and edit the

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soundsets and tables. For example, you might want the dog's bark to be repeated four times, then have the sound of the hammer going off in a machine gun burst 10 times.

The Audio Opcodes section has several machine language programs to install in your own programs. These include Squalk, to play sounds from a soundset; Jabber, a high speed multisqualker; Heartape, that transfers the signal of the cassette input port directly to the speaker until the appropriate key is pressed.

As your cassette player belts out a song through an auxiliary speaker, the graphic on the TV or monitor will keep the beat.

It also offers Audio-in, which loads sound from the cassette port into memory in 256-byte pages; Playback, which can take data from memory and play them back through the speaker as if they were sounds; and Tone, which generates single high-precision tones.

I wish there were some way the user could get printouts of the various screen patterns. These might be helpful to experimenters.

I also found it was necessary to blend short sounds rather than use long ones. A word like "three" takes up a great many pulses. As the manual explains, the program is for sound effects rather than voice.

Overall, however, I would have to say that this is a very interesting and complete program for anyone interested in playing with sound. For the price, it is an amazing value.

Sight 'n Sound

If it were only possible—and I'm sure some bright programmer will uncover a way—to blend a sound utility with this one . . . . As it stands, *Sight 'n Sound* by Ray Balbes is one of the most unusual utilities I have ever run across.

Basically, it is designed to animate a specific type of Apple graphic in time to voice or music from a separate sound source. That is, as your cassette player belts out a song through an auxiliary speaker, the graphic on the TV or monitor will keep the beat.

I saw something like this at a word processing trade show once. At the IBM booth was a large TV screen with a cartoon of a man. He would look left, right, or straight ahead, gesture, and move his mouth.

Hovering in the background, I'm sure, was an IBM employee with a microphone who might say "You, madam, in the gray suit. Aren't you impressed with the way our new Displaywriter operates?" The little cartoon would move its mouth in time to this, the woman in the gray suit would stutter, and the crowd would chuckle appreciatively.

Sight 'n Sound could do the same sort of thing—that is, move the mouth—using an Apple. According to the memory map in its 22-page instruction booklet, it does this by taking up memory from hex 800 to 8000.

This area includes the main *Sight 'n Sound* program, primary and secondary hi-res screens, and other information.

It is a copyable program, although if you want a DOS 3.3 copy you will have to Muffin the 3.2 version.

creative computing
SOFTWARE PROFILE

Name: Sight 'n Sound
Type: Graphic/sound utility
System: 48K Apple II; cassette recorder or stereo required
Format: Disk
Language: Basic and assembly
Summary: Animate your programs to music
Price: $26.95
Manufacturer:
Compugraphics Software
6 White Plains Dr.
St. Louis, MO 63017

Kaleidoscope

There are two formats for *Sight 'n Sound* shows. One is a kaleidoscope using shapes stored on the disk. You can use a standard drawing program to make the shape, then save it under an SH designation. Any of nine shapes can be saved and inserted into the kaleidoscope.

The program divides the screen into four sections. Enter the coordinates at which the four shapes should begin, and the color in which the shapes should be drawn.

When you begin playing music or voice through the Apple, the frequency makes the shapes move away from the center in the appropriate direction. The higher the frequency, the farther the movement. Treble will affect movement, but volume has nothing to do with it.

You can select five parameters for the kaleidoscope. First is the length of time the program monitors frequencies before putting a display on the screen. Higher numbers give greater displacement but less synchronization.

Second is scale. Each increase or decrease of 1 doubles or halves the displacement.

Next is density. This adjusts the number of complete shapes that can be on screen at any time.

There is also a wraparound option for use when the frequencies shoot the shapes offscreen; and the kaleidoscope option. If this is ON you can use the kaleidoscope effect, and also change shapes.

A background for the kaleidoscope can be added by BLOADing, DRAWing, or HPLOTing to a secondary screen. This is explained in a sample progam that is included in the instructions.

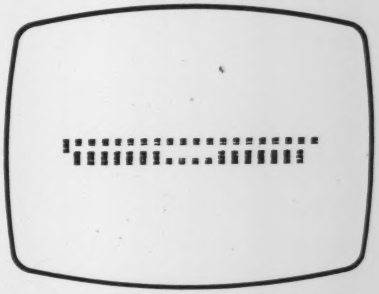
Line Format

It is the line format section of the program that interests me, however. Set the kaleidoscope option to OFF, and the line format begins to operate.

With this one, you enter a series of points, each with its own direction (or instructions to remain stationary) and color. Each point automatically connects to the previous one with a line.

When you play sound through the machine, each point reacts to its individual instructions. The first three parameters used in the kaleidoscope section are also here in effect. Each point stands still, or moves in the direction you have chosen for it and st-r-e-t-c-h-es the line with it.

I plotted the points for a pair of lips, for example. When I played music through it, the lips moved in time.



Sight 'n Sound design line with no sound.

(Once again, I selected Groucho's "Lydia The Tattooed Lady" as my subject matter. "For two bits she will do a mazurka in jazz, with a view of Grand Canyon that nobody has . . .And on a clear day, you can see Alcatraz. You can learn a lot from Lydia.")

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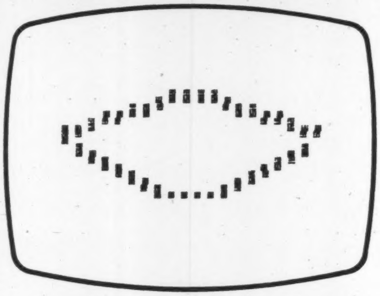
Sound Software, continued...



Sight 'n Sound design line with sound. Ends are stationary: top line moves up; bottom line moves down.

You can display the various points in memory at any time in text. This gives you the hi-res X,Y coordinates, the direction the point will move, and the color. The color is determined by the following point. That is, if point 3 is blue, the line from point 2 to point 3 will be blue.

It is possible to plot a color black1 or black2 which will not be visible when the program is operating.

Improvements

Sight 'n Sound needs stronger error-trapping, however. You can work on only one shape at a time. If, when you are finished with the shape, you accidentally hit number 4, Create New Data, instead of 3, Run Data in Memory, you lose everything you have created. Save the data on disk, and to add on more points you are forced to insert each one singly.

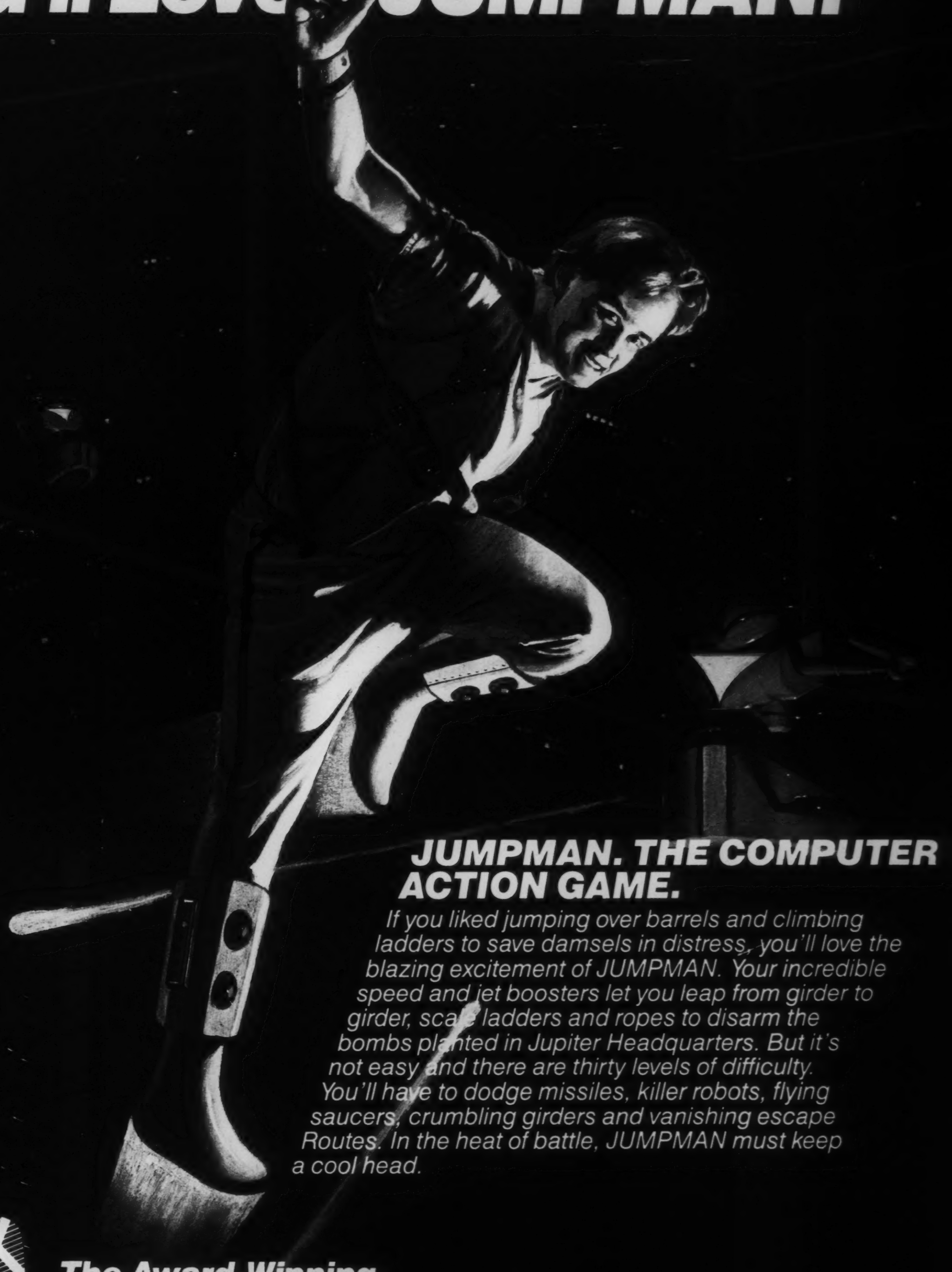
Your kaleidoscopic shape could be the guest of honor's name, age, or whatever.

There should be an Add Points on the menu along with the Change, Insert, and Delete a Point. I would like to be able to see what a shape looks like, then be able to jump back to continue working on it. It would also be handy to be able to print out the data in memory.

Even with its flaws, this is a novel program that could be useful for commercial applications of some kind. You might also enjoy trotting it out at a birthday party, for example. Your kaleidoscopic shape could be the guest of honor's name, age, or whatever.

Like all good utilities, *Sight 'n Sound* offers a great deal of scope for the user's imagination. ☐

If You Liked Donkey Kong, You'll Love JUMPMAN!



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JUMPMAN Designed by Randy Glover
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Word Juggler™ IIe.

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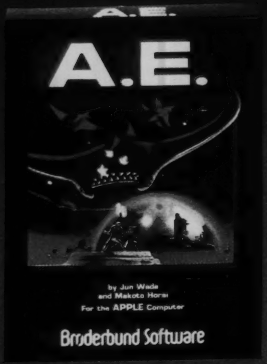

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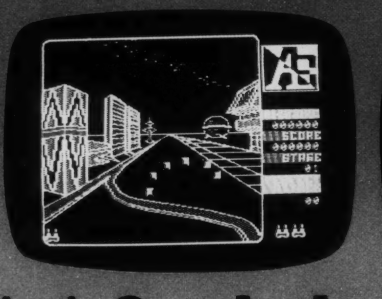

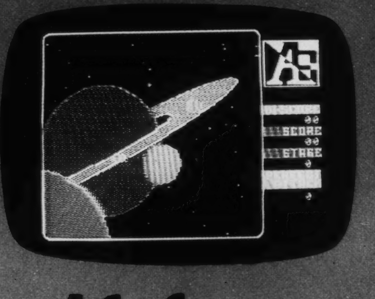

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Brøderbund Software

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CIRCLE 123 ON READER SERVICE CARD

Making Music With Your Vic

Shelby Goldstein

Whether you're a music pro, a computer whiz, or an amateur dabbling for the first time in either field, you can make great music with the Commodore Vic 20. The Vic comes with four-voice, music making capability built in, and now there are three software programs available that can help you take advantage of that capability.

Piper

Piper from Abacus Software enables you to compose and play one-voice music with ease. Music is entered into the computer much as you would write a Basic program, although you need not be a programmer to use *Piper.*

Notes are indicated by their letter names, which makes it quick and easy. For example, the note C is played simply by typing C, not POKE 36876,195. Note values are specified by adding a number after the letter name. C/4, for example, indicates the note C played as a quarter note. To enter a half note C, you type C/2.

The Vic has a five-octave range. With *Piper*, you indicate the octave that you desire by inserting its number between the letter name and the note value. For example, a quarter note C in the fifth octave would read C5/4.

> **Piper *is easy to use and fast.***

Sharps or flats are added by entering their sign next to the letter name C#5/4. Rests are inserted by typing R. A quarter note rest, for example, would read R/4.

The following is a sample program that plays a D major scale:

```
 1 RUN "<CLR>"
10 TBO
20 D4/4 E4/4 F#4/4 G4/4 A5/4 B5/4 C#5/4 D5/4
30 END
```

Line 10 sets the tempo, which can vary from 15 to 255. In addition, phrases can be repeated, and volume can be controlled. You can also display the lyrics as the music moves along. *Piper* even allows you to control certain elements while the music is playing. For example, you can instruct the computer to skip a subroutine, repeat it, or go to a different subroutine.

As you enter music into the computer, you can play it back immediately to check yourself, or you can enter the

creative computing
SOFTWARE PROFILE

Name: Piper

Type: Music composer

System: 5K Vic 20

Format: Cassette, disk

Language: Hybrid

Summary: Quick and easy to use, for a single voice.

Price: $19.95 cassette, $22.95 disk

Manufacturer:
Abacus Software
P.O. Box 7211
Grand Rapids, MI 49510
(616) 241-5510

Shelby Goldstein, 328 E. 66th St., Apt. #2, New York, NY 10021.

entire composition and then play back and edit. Music can also be saved to disk or tape for replaying at a later time.

Piper is easy to use and fast. Keep in mind, though, that you can enter and play only one voice at a time.

Vic Music Composer

If you need a program that enables you to compose two- or three-voice music and play all voices simultaneously, then you should consider *Vic Music Composer* from Thorn EMI.

Vic Music Composer by Martin G. Taylor allows you to play as many as three voices simultaneously. However, you can enter only one voice of music at a time.

As with *Piper*, you can stop at any time and edit or play back to check yourself and edit. Once you finish one voice of your composition, you can play it back, add a second or third voice, and save it all on tape or disk.

Music is entered into the computer by placing notes on a graphic representation of a musical staff. You first choose the key, time signature, and voice in which you wish to compose. You then use cursor controls to select the note value and move it to the chosen place on the staff. Rests are located in the same manner. Once a note is in place, a sharp or flat can be added by pressing certain keys. Bar lines are inserted by simply pressing the B key.

While not as fast as *Piper*, this method of entering music has a couple of advantages. Using it, a non-musician can create music on the Vic simply by copying notes from sheet music and putting them in their proper places on the staff. In addition, this method of composing is more common among professional musicians, who tend to think of and write music as notes on a staff rather than as letter names.

creative computing
SOFTWARE PROFILE

Name: Vic Music Composer

Type: Music composer

System: 16K Vic 20

Format: Cartridge

Language: Machine

Summary: Some trade-offs, but three-voice capability.

Price: $39.95

Manufacturer:
Thorn EMI
1370 Ave. of the Americas
New York, NY 10019
(212) 977-8990

Other features of *Vic Music Composer* include ease of editing with cursor-controlled deletion and insertion. Also, volume can be changed within the piece as often as you wish simply by entering a number from 1 to 6 beneath the staff. A variety of tempos can be used by choosing various numbers from 1 to 9.

As you play back your composition, you can choose which voice you wish to have displayed. Unfortunately, you can display only one voice at a time even though you may be hearing two or three. There also doesn't seem to be a way to listen to only one voice if you have composed a two- or three-voice piece; you must always listen to all three.

One other disturbing omission is the ability to hear repeated attacks of the same tone. For example, if you enter four quarter note Gs, they will be heard as one whole note G. This can change the sound and feel of many tunes significantly.

In spite of these disadvantages, *Vic Music Composer* is a superb program. It allows you to compose, store, and play back as many as three voices simultaneously, using standard music notation. Entering and editing music is fairly fast

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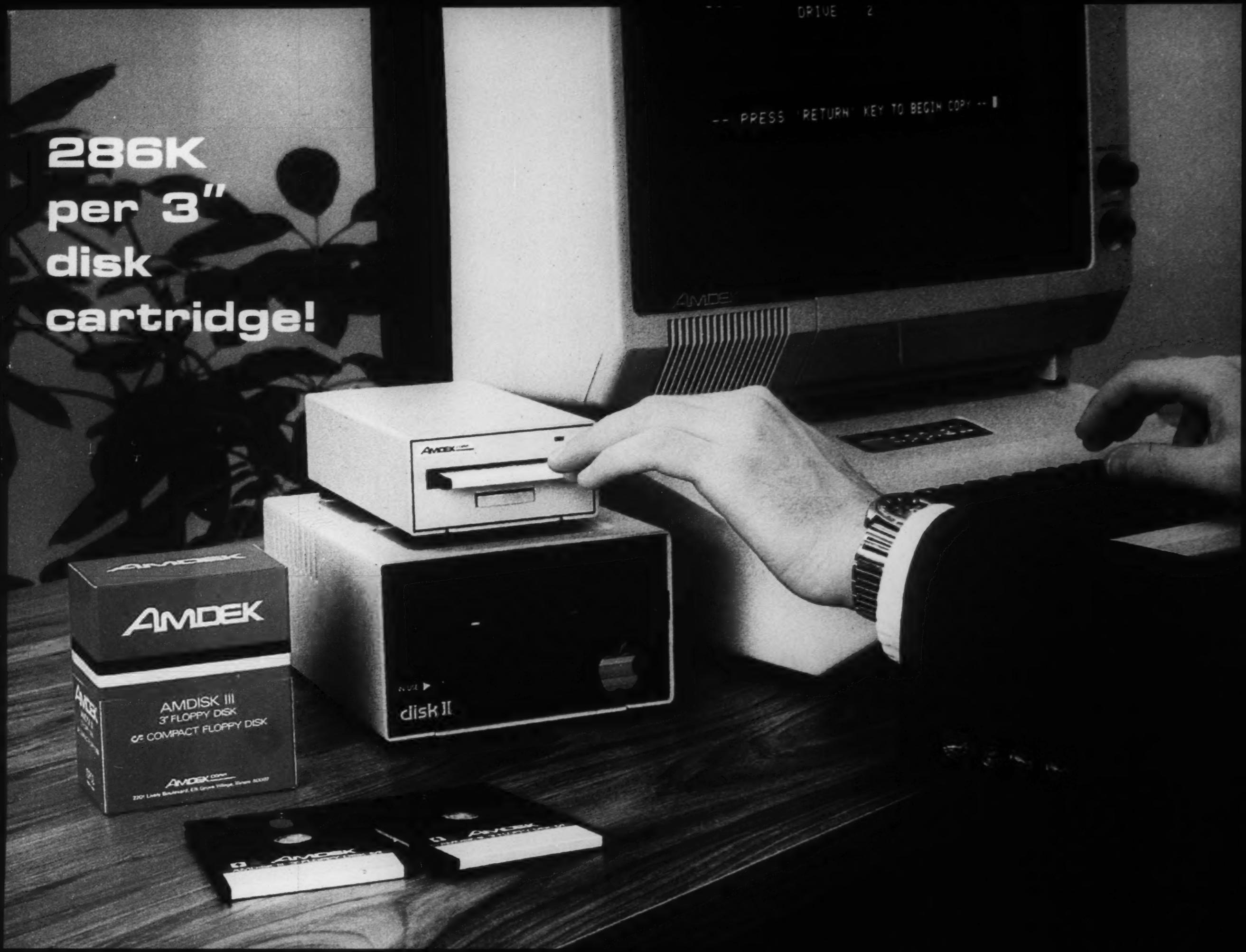
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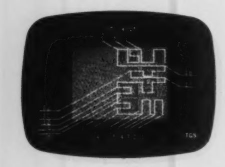

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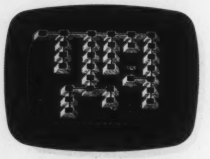

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3750 Wright Place, Palo Alto, Calif. 94306 Telephone 415-856-6505

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and easy. The program comes in a convenient ROM cartridge and, like *Piper*, requires no memory expansion.

Synthesound

However, if you are more interested in creating a variety of sounds than in using musical notation and saving compositions, *Synthesound* from HES may be for you.

Synthesound, by T. Dachsel and D. Hassinger, turns your Vic 20 into an exciting music synthesizer. Like the other two programs, it helps if you know something about music, but it is not necessary. Even a novice can create many different sounds and special effects by fooling around with this program.

Synthesound uses three voices within a four and one-half octave range. Using attack, decay, sustain, and release controls over the three-voice oscillators, you can create a variety of sounds, from bagpipes to a piano to a police siren.

There are two parts to the program: player mode and programmer mode. In player mode, your Vic keyboard becomes a musical keyboard. By pressing certain keys, you produce notes of the scale, songs, or some pretty wild sound effects, all depending on what controls you have set in programmer mode.

Programmer mode is the part of the program in which you control the ADSR envelopes (attack, decay, sustain, release) of the three voltage controlled oscillators, your three voices. Basically, the way you set the ADSR of the three voices determines whether your tone will sound like a violin or like a trumpet. While there are other factors involved in the production of a sound (such as low frequency oscillators), and while it does require quite a bit of musical knowledge to understand music synthesis fully, most people can have a great deal of fun creating a wide variety of different sounds with this program.

Other features of *Synthesound* include an optional illuminated keyboard in player mode and a four-voice sequencer for repeating musical or rhythmic patterns. The only really disturbing drawback of *Synthesound* is the inability to save the sounds you create. Once you turn off the machine, that's it. This can be very frustrating if you have spent hours finding just the right kind of sound and there is no way to recall it during future sessions.

When questioned about this missing feature, a representative of HES explained that it would have required twice as much memory to incorporate this feature, and the retail price would then have doubled as well. One wonders if it wouldn't be worth the extra money, and also if there isn't a way to incorporate that feature without using so much extra memory.

At any rate, *Synthesound* is an excellent program. It, along with *Piper* and *Vic Music Composer,* now offers a variety of ways with which to create music on your Vic computer. If you haven't tried any of them, you are really in for a treat. □

creative computing
SOFTWARE PROFILE

Name: Synthesound

Type: Music composer

System: 5K Vic 20

Format: ROM cartridge

Language: Machine

Summary: Excellent program with many capabilities.

Price: $59.95

Manufacturer:
HES
71 Park Lane
Brisbane, CA 94005
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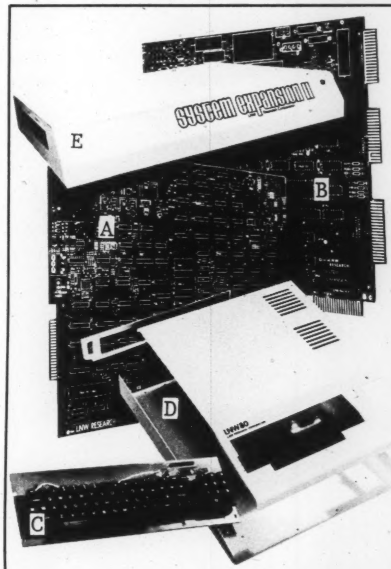

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Geap Dot Writer

R. W. Steur

I had read with envy the reviews of the GEAP graphics editor and programmer package distributed by RCM Computers. But having a printer without block graphics capabilities (the original Epson MX-100), I found myself out in the cold. So I was pleased to find that a new expansion module for GEAP permitted the MX-100 to print block graphics, albeit slowly.

At the same time I made an even more exciting discovery—the new *Dot Writer* package from the same firm. *Dot Writer* is part of the GEAP family and works hand and glove with it and with your word processor to open a whole new world of word processing possibilities.

Dot Writer version 1.5 is available for the Epson MX series printers with either the Graftrax 80 or Plus ROMs. A new version has just become available for the C. Itoh 8510 series and the NEC 8023A printer. *Dot Writer* is available only on disk and appears compatible with most DOSes.

There are really three major parts to the *Dot Writer* package. The first part is Dotprint, which is the print module used to print an ASCII text file prepared with any word processor producing such a format, including *Newscript, Scripsit, Electric Pencil II* and *Lazywriter.* The text is typed in as usual, imbedding the special Dotprint commands, and the file is saved. At print time the Dotprint program formats the text.

The second part is the Dotwrite editor, which permits creating, test-printing and saving to disk of everything you create or modify. When you use this editor, you also have available all the editing power of GEAP as well as the specialized high-resolution commands of Dotwrite. Anything created with GEAP/Dotwrite can be printed using the Dotprint module.

The third portion of *Dot Writer* is the character font library. Twelve different fonts come with the package. These can be expanded, magnified, and reversed by Dotprint commands.

One additional program included in the *Dot Writer* package is a Basic subroutine which can be included in your own programs to bring high-resolution graphics created with Dotwrite. The manual cautions that programming experience is required.

Documentation

Speaking of the manual, it is very good. Everything is clearly explained, including a section on file management for various disk configurations. Good examples of the various commands and functions assist in understanding and using them quickly. A helpful touch is the use of different colored pages as flags to find the various sections.

The Dotprint Module

The Dotprint module can serve as the scripting or formatting module for any word processor producing an ASCII file, but *Newscript* is a particularly logical choice (and recommended by RCM computers) since the Dotprint command format and structure follow that of

creative computing
SOFTWARE PROFILE

Name: GEAP Dot Writer Version 1.5

Type: Character and font generator

System: TRS-80 Models I and III,
Epson MX, C. Itoh 8510
series and NEC 8023A
printers

Format: Disk

Language: Machine language

Summary: A flexible, easy to use utility for word processing.

Price: $99.95, Accessory font disks: $29.95

Manufacturer:
RCM Computers
221 Hirschfield Dr.
Williamsville, NY 14221

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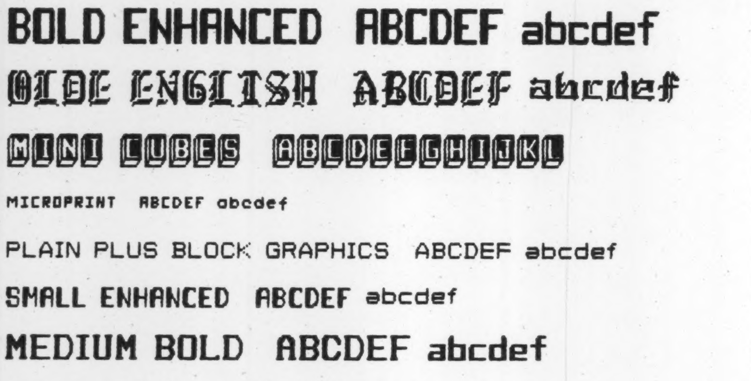
Newscript plus some special commands of its own. Missing are the run-time options of *Newscript* but Dotprint does have the KE command for keyboard input during printing and, most important, the IMbed and APpend commands for disk files.

Probably the most significant feature of Dotprint is its ability to print in bit image mode the variety of lettersets in the font library. There are roughly 50 fonts available now, and the number is growing. A very limited cross section is shown in Figure 1. In addition, Dotprint supports the regular Epson font as an alternative.

Dotprint has been provided with a very useful and adaptable underlining function. The examples in Figure 2C show how either individual words or both words and intervening blanks can be underlined. The position of the underline can be adjusted to suit the various character sets, and multiple and/or thickened underlining is a breeze. Single or multiple thickened lines can be printed across the text space without text, as shown in Figure 2.

Small hi-res drawings as seen in part D of Figure 2, can be included within a text line as part of either the main font or the alternate font. To use larger drawings in the text, the hi-res drawing can be created using the Dotwrite editor, saved to disk as a bit-image file, then included in the text by use of the IMbed 'filename' command.

Letters and drawings can be magnified before printing by a simple command, with results such as those in Figure 2F. Two centering commands are available: the first is exactly like the *Newscript* command and is used for nonproportional printing; the second is used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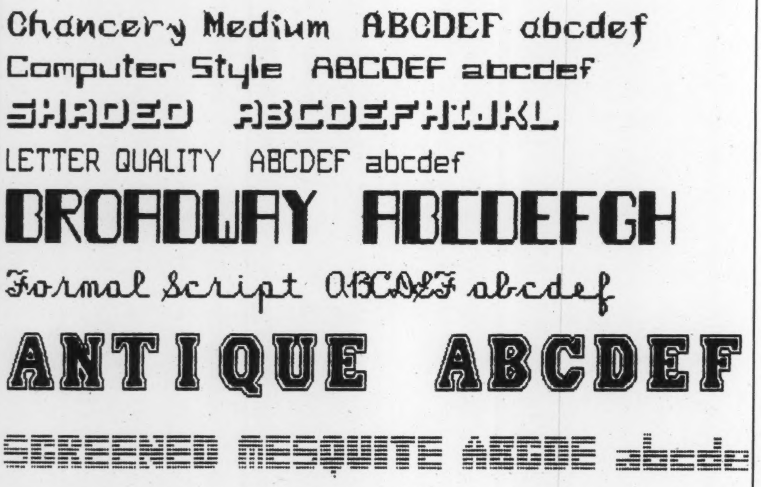
OLDE ENGLISH ABCDEF abcdef
MINI CUBES ABCDEFGHIJKL
MICROPRINT ABCDEF abcdef
PLAIN PLUS BLOCK GRAPHICS ABCDEF abcdef
SMALL ENHANCED ABCDEF abcdef
MEDIUM BOLD ABCDEF abcdef

A. Sampling of lettersets supplied with Dot Writer.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Computer Style ABCDEF abcdef
SHADED ABCDEFHIJKL
LETTER QUALITY ABCDEF abcdef
BROADWAY ABCDEFGH
Formal Script ABCDEF abcdef
ANTIQUE ABCDEF
SCREENED MESQUITE ABCDE abcde

B. Small sampling of additional fonts available.

Figure 1. Examples of the variety of lettersets available.

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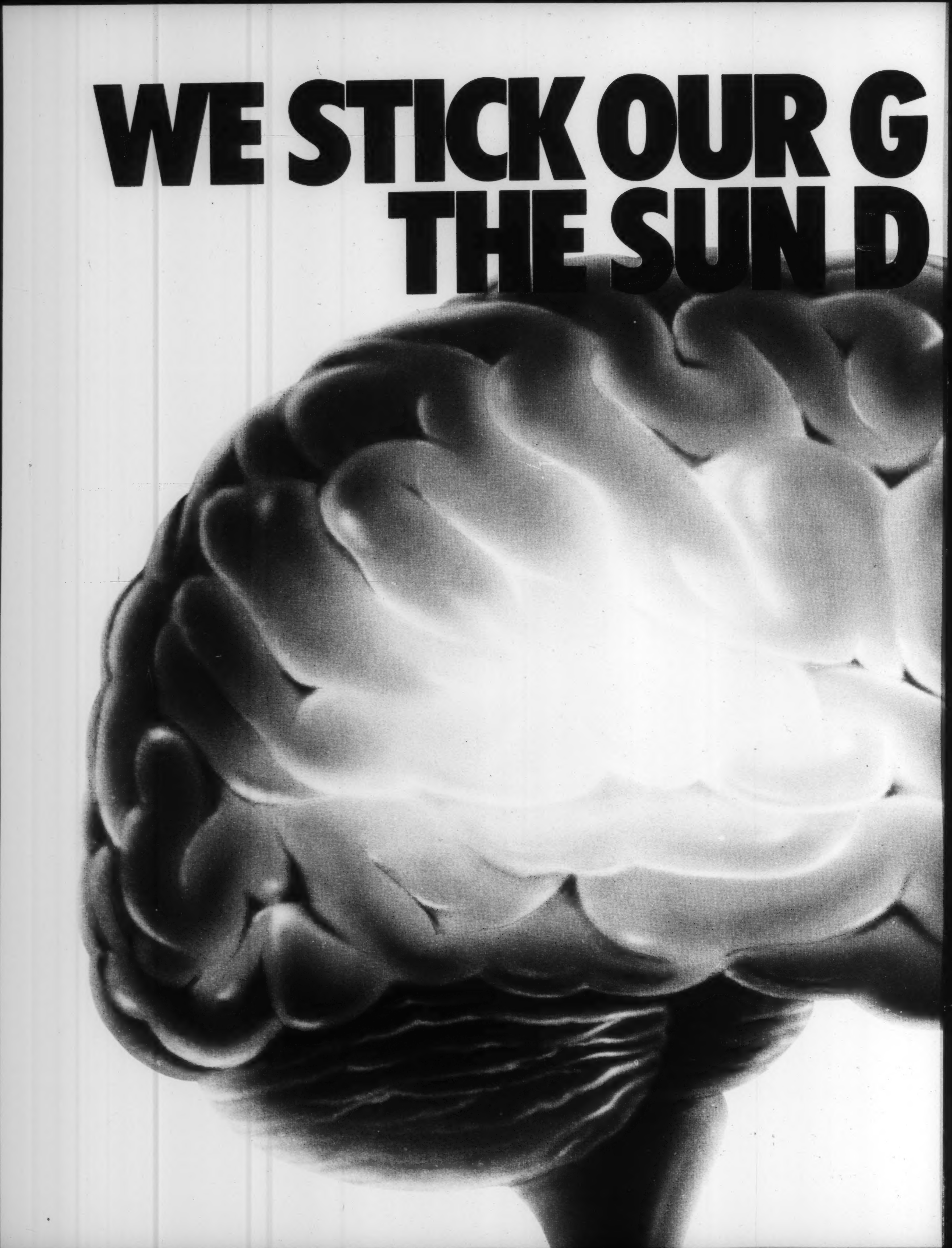
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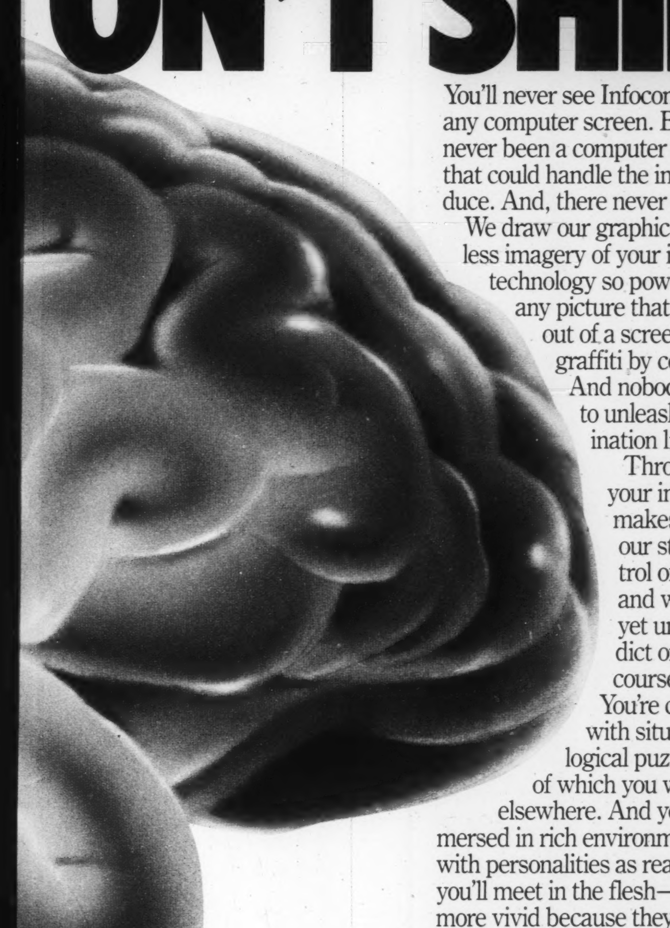

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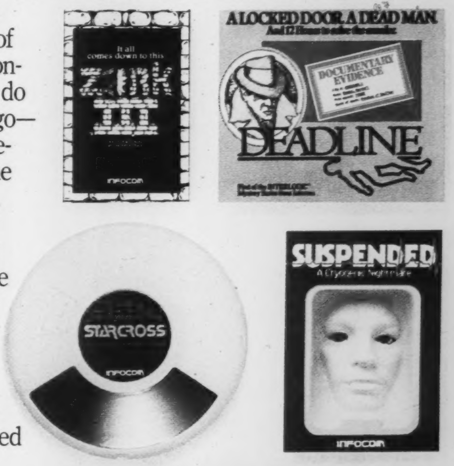

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only when the proportional printing option is in effect.

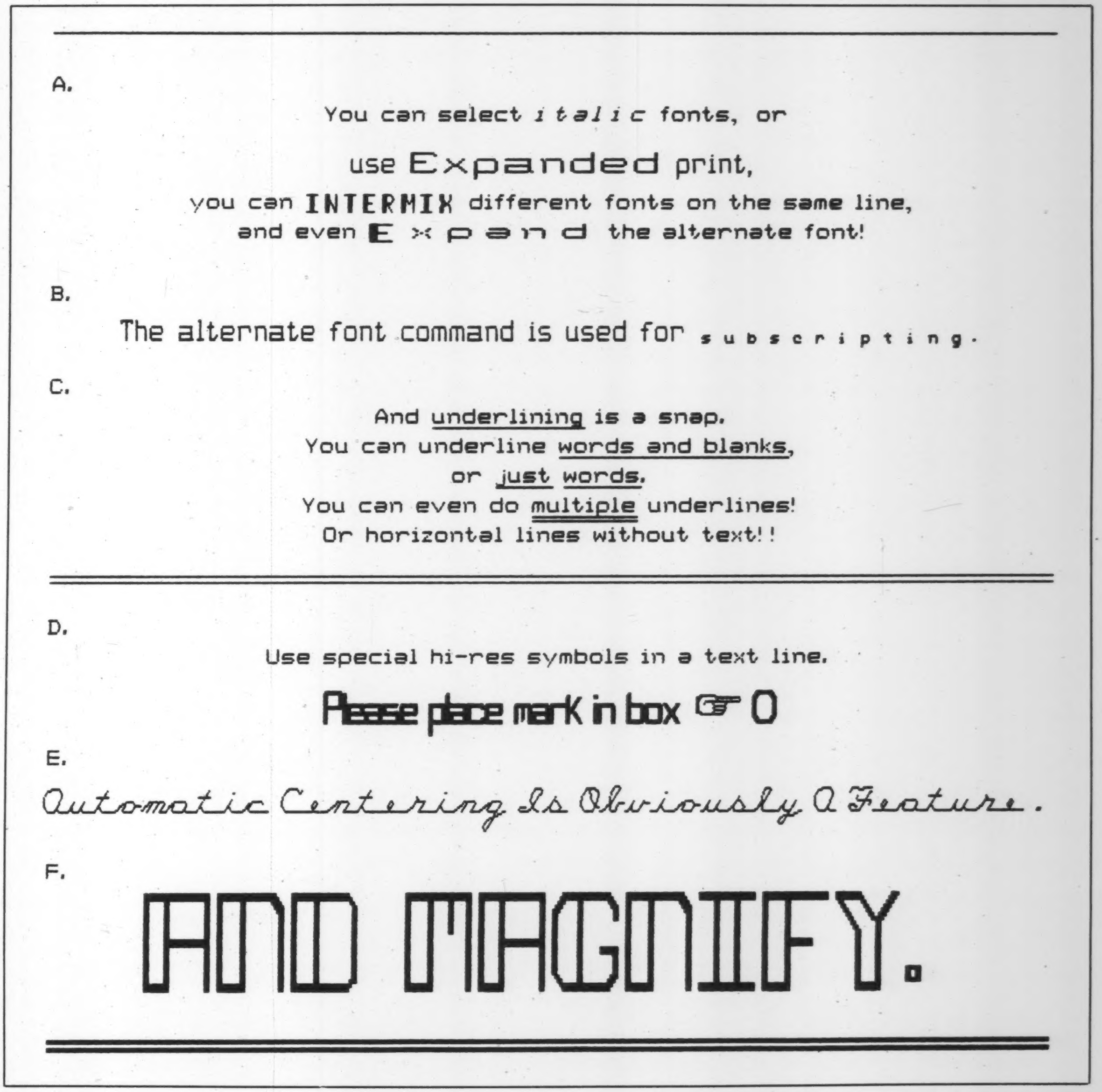
Did I say proportional printing? Yes I did—but I have an Epson printer, which doesn't have a proportional font. But I said it and Dotprint does it with Dot Writer Letterset fonts, though not with the regular Epson fonts. Figure 3 demonstrates both the versatility and the effectiveness of the proportional printing function.

The Dotprint SDn controls the dot spacing between letters whether in mono or proportional spacing, while SWn controls the minimum width of blank spaces when in proportional spacing mode. The effects of these commands are illustrated in Figure 3.

Use of the proportional print option provides a printout that is very professional looking. Control of both the inter-character and inter-word spacing allows variation of not only the appearance of the text but the amount of space required as well. It should be noted that the current version of Dotprint does not support proportional printing of very large letter fonts which cannot be held completely in RAM, but it is hoped that future versions will overcome this restriction.

There are several more features of Dotprint worth mentioning. The IGnore command provides a means for including non-printed comments within the text file but, in addition, also permits some debugging of the imbedded commands in your text file without actually printing out the complete text using the *Dot Writer* fonts. This can save considerable time.

A darkness control, DA n, controls



A.

You can select italic fonts, or

use Expanded print,

you can INTERMIX different fonts on the same line,

and even Expand the alternate font!

B.

The alternate font command is used for subscripting.

C.

And underlining is a snap.

You can underline words and blanks,

or just words.

You can even do multiple underlines!

Or horizontal lines without text!!

D.

Use special hi-res symbols in a text line.

Please place mark in box ☞ ☐

E.

Automatic Centering Is Obviously A Feature.

F.

AND MAGNIFY.

Figure 2. Some Dotprint features.

double strike while EM on/off is for emphasized print mode; the two can be used at the same time for a very solid black printout.

The MF n command magnifies the resident font by a factor of n, both vertically and horizontally. Thus, it is not the same as the double width function. Excessive magnification does result in somewhat ragged characters, however.

I mentioned that I was pleased to find that GEAP could print block graphics on my Epson MX-100. I was even happier with the ability of Dotprint to utilize block graphics as part of a text file. The block graphics set is included in the font supplied as part of the *Dot Writer* package. The lo-res graphics file is imbedded in the text file and printed as part of the file, as seen in Figure 4A, while in Figure 4B the corresponding hi-res figure in bit image format has been printed.

Surely this must be the answer to all our word processing formatting problems, right? Wrong. We haven't quite reached perfection yet. The primary limitation of the capabilities of Dotprint is speed. First, almost all of the *Dot Writer* lettersets require two passes (two lines, eight dots high) to print. Next, bit image printing in the Epson and NEC printers must be unidirectional to maintain precise vertical alignment within characters. Further, total printing time is increased by the use of frequent font changes, with resulting disk accesses. An elaborate document could take a while to print out using Dotprint, but the result can be well worth the wait.

The Dotwrite Module

Now let's take a look at the Dotwrite portion of *Dot Writer*. This is actually a pair of GEAP expansion modules and can be used only in conjunction with GEAP vers. 2.1. Programming bit-image graphics for printers with this capability is an involved and tedious task. The GEAP Dotwrite program was designed to do all of the bit-image graphics programming for you.

Dotwrite has three purposes:

- Printing *Dot Writer* lettersets in text form.
- Creating lettersets and modifying existing ones.
- Creating hi-res graphics.

You use the TRS-80 screen as a sketch pad to draw letters or artwork. As you progress you can send your work out to the printer to see how it looks in bit-image form. Then when you are satisfied with the result, the program converts the screen image into bit-image format and stores it on disk.

There is also a Dotread module supplied which is a stand-alone Basic program to print a file created by the Dotwrite "output to disk" option. This can be merged into your Basic application program to provide individual and outstanding printouts for your programs.

The ability to print text directly from Dotwrite is useful for creating posters, notices, etc. Text can be entered from the keyboard or loaded from a disk file, using a previously created printer setup file or creating a new one.

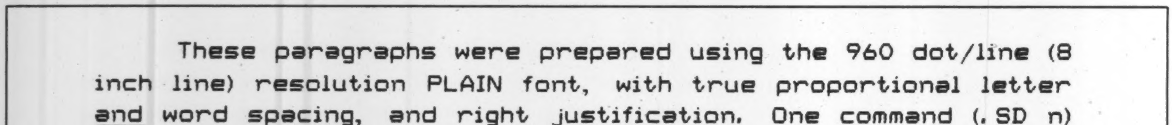
If you were starting from scratch, you would first load the letterset you want to use, then a command is given to allow the program to determine the screen limits, based on your answers to a series of questions which appear on the screen. After this, a vertical line appears on the screen. This represents the limit of the characters which will fit on the paper.

Key in your text, within the screen window, and when you are through, you go to the print mode. At this point you have several printing options from which to choose.

As I mentioned, there are many letter fonts available. But suppose none of them quite fits your needs or wants. Then create your own or modify an existing one. Block graphic pixels are used to draw the letters on the screen and represent the dots in the bit image format.

Letterset Manipulation Utility

During preparation of this review a



These paragraphs were prepared using the 960 dot/line (8 inch line) resolution PLAIN font, with true proportional letter and word spacing, and right justification. One command (.SD n) allows the intercharacter spacing to be changed, as in the following examples:

Proportional letter spacing control. (.SD 1)

Proportional letter spacing control. (.SD 3)

Proportional letter spacing control. (.SD 5)

A separate and independent command (.SW n) permits the width of the blank space between words to be adjusted as a fraction of letter width. The result is shown in the lines below:

Proportional word spacing control. (.SW .3)

Proportional word spacing control. (.SW .5)

Proportional word spacing control. (.SW .8)

The above text was printed using an Epson MX-100 printer with GRAFTRAX Plus. As a final example, the first line below was printed with proportional spacing, the second with normal spacing.

Proportional print test.

Proportional print test.

Figure 3. Proportional printing with an Epson printer.

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GEAP, continued...

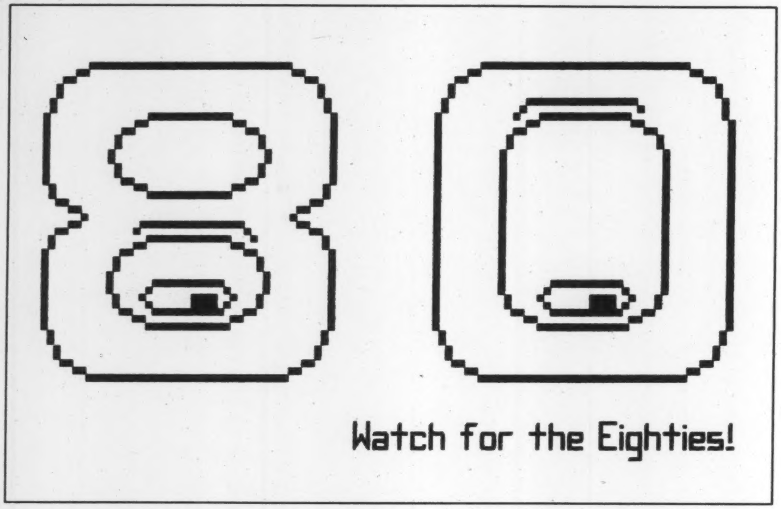
Watch for the Eighties!

Figure 4A. Block graphics printing with Dotprint.

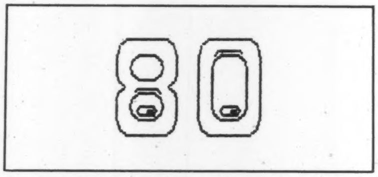

Figure 4B. Equivalent hi-res drawing with Dotprint.

new Dot Writer module became available. The Manipulation Utility module consists of a group of routines which were developed originally to assist in the creation of lettersets by the author of GEAP. It is intended for use by those familiar, if not proficient, with the GEAP and Dot Writer programs. A variety of routines is provided for the manipulation of individual characters or complete lettersets. I have found certain ones particularly useful to me.

For example, suppose you have created the capital letters of a letterset and don't want lowercase. To avoid the problem of an unshifted (lowercase) letter in the text file, simply use the copy between lettersets utility to copy the uppercase letters into lowercase positions as well. Shifted or not, you'll get the uppercase you want.

You want to print a small hi-res figure as part of your text; what's the simplest way to accomplish that? Well, if there were a blank spot in the letterset you were using, it could be put right in there. And how do you find the blanks? Why, option 4 of the Manipulation utility will do it for you and list them to the printer.

A move routine permits you to move a letter or series of letters within the frame, and/or center or justify the letter(s). There are other options, for magnification and for special effects like adding "wiggles" to a letter, but they are icing on the cake.

Program Support

One aspect of software that most of us are quite sensitive about is the support provided by the manufacturer. My own experience with RCM Computers has been reassuring in this respect. For example, I found a bug in the IGnore command and within a few days of contacting RCM Computers I received a patch which took care of the problem. The company is quite responsive to users' comments and suggestions. Further, their update and upgrade policies and pricing are very reasonable. They are developing a User Library to which users can contribute and so share their talents with others around the country.

Conclusions

What lies ahead for this program? I expect that it will be adapted to more bit-image printers, certainly. The GEAP family of programs has expanded so rapidly that I would be very much surprised if new versions with increased flexibility, utility and ease of use were not forthcoming in the near future.

The *Dot Writer* programs have expanded the word processing capabilities of the TRS-80 Models I and III to an extent not imaginable, at least by me, as late as the end of 1981. In conjunction with a powerful text editor such as *Newscript, Dot Writer* provides the TRS-80 user with almost limitless word processing possibilities in business and recreation applications. This is a best buy if you are involved in word processing and have or plan to buy an appropriate Epson, C. Itoh, or NEC printer. ☐

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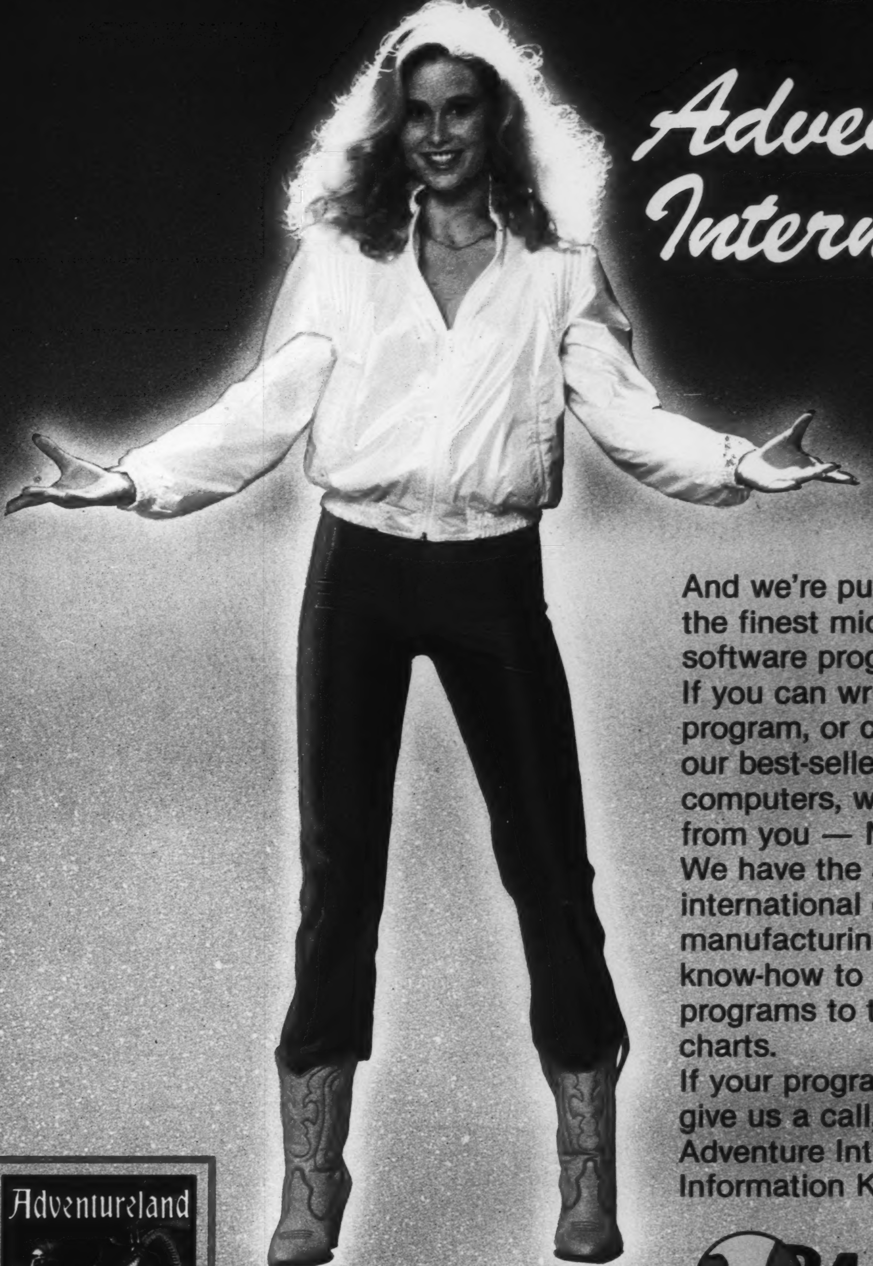

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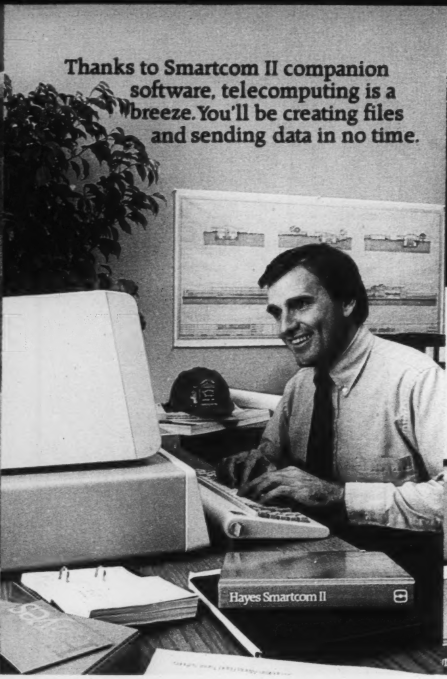
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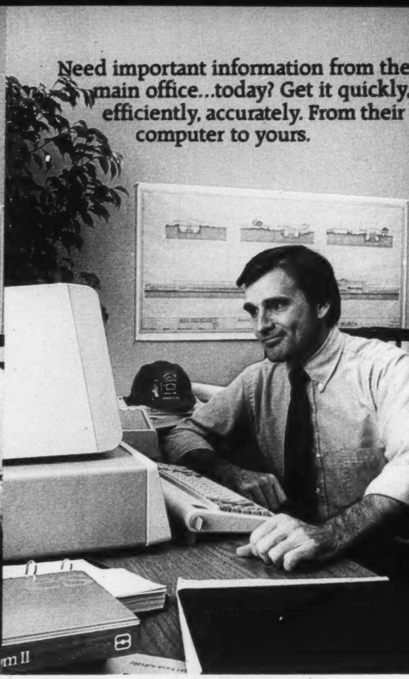
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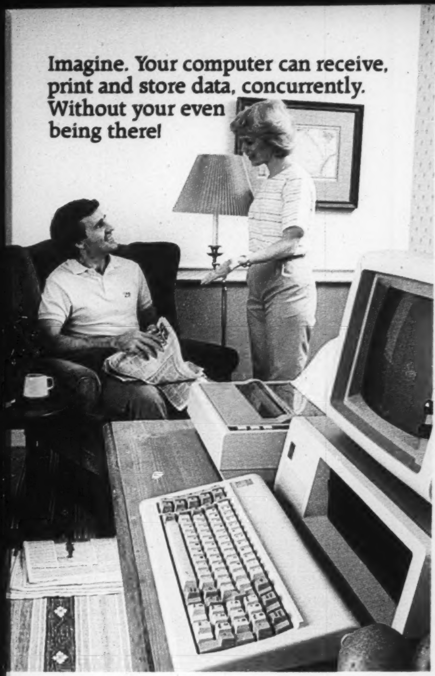

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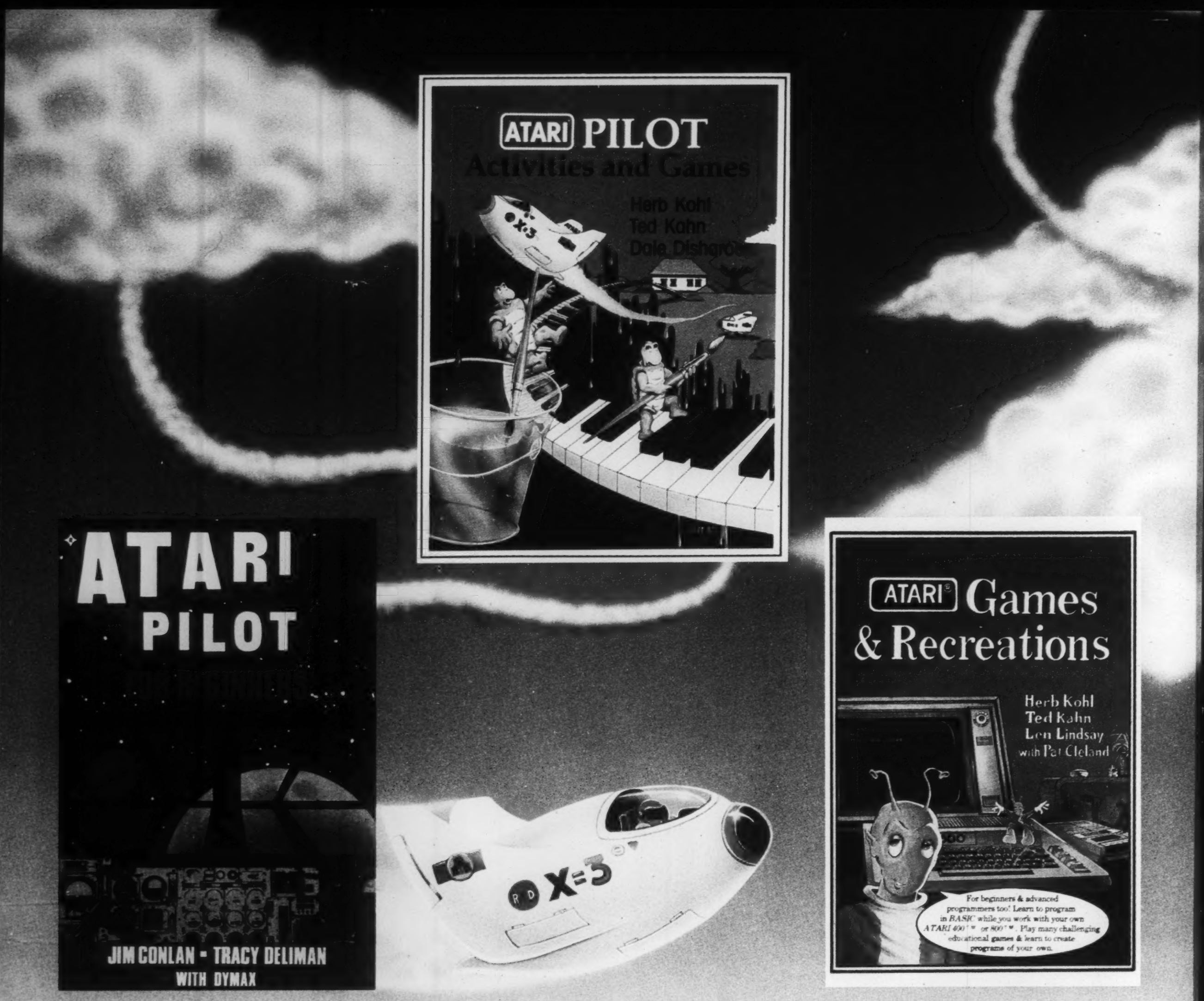
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Hello, my name is 420724-7091

...and Sweden's central data banks know everything about me

Chris Mosey

Allow me to introduce myself. I am 420724-7091. My wife is 480930-7343 and our seven-month-old baby daughter is 810130-0443. We live in Sweden, where our lives are numbered.

Of course, you would be far more interested in 451115-9305, 450425-4931, 461216-0038, and 500405-2444. I understand they've sold a lot of records in the States.

Why, during the last administration they even visited the White House on one of their tours. Except for 500405-2444, who was indisposed.

Everyone in Sweden has a Person Number. Of course we also have names just like you. My wife's is Lola, our daughter's, Nina Suzanne.

And the numbers in the second paragraph refer to (in the order mentioned): Annifrid Lyngstad, Björn Ulvaeus, Benny Anderson, and Agnetha Fältskog, members of the pop group Abba, one of Sweden's most successful exports.

The Person Number is allotted to you by the government as soon as you settle in Sweden. Even foreign correspondents staying for a limited time have one.

It is on your ID-card, your driver's license, tax declaration form, and all official documents relating to you.

The first part is your date of birth. I was born in (19)42, on July (07) the 24th. Hence: 420724. The number after the dash is chosen at random, except for the penultimate digit. If it is odd you are male; if it is even (including zero), female.

Sometimes the Person Number system can seem a trifle sinister. If you are stopped by the police, your number is fed via walkie-talkie into a computer at headquarters. Within minutes the cop on the beat will know all there is to know about you—more specifically if you are on the wanted list or have previous convictions.

Sometimes it can make life easier, however. If you want credit, you give your Person Number and within a remarkably short time information is released from a central data bank which gives the company evidence of your creditworthiness (or lack of it). The data bank has to inform you about all such inquiries.

Swedes like the Person Number because it is efficient. They register amazement that anyone should find it Brave New World-ish. 480930-7343, for example, does not go around saying how glad she is to be a 480930-7343 but she *is* glad that it expedites the children's benefit that the state pays for 810130-0443.

There is a danger that it could all go too far, however.

The national social welfare board this month came up with a revolutionary scheme to lessen the burden of the welfare state by an estimated 4 million kronor ($800,000).

This is the amount it loses each year because people mislay their false teeth.

The board is now calling for a law stipulating that all sets of false teeth be stamped with the owner's Person Number so that when they are found they can be returned, avoiding the need to make a new set.

It is a very Swedish solution and it is as true as my number is 420724-7091...even if it is a little hard to swallow. □

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Bytes, Camera, Action

John J. Anderson

Let's consider the generation of colorful, animated microcomputer graphics. Sure, you can talk about Basic, and Forth, and Pascal, and (gasp) machine language. You may even raise the issues of bit-mapping and shape tables. But let's face it. There resides in an area frequently and euphemistically referred to as the "real world," a group of artistically inclined people, interested in the prospects of expressing themselves through colorful, microcomputer-generated graphics, who are not crack computer programmers, nor will they ever be. To reach that goal, they need better, friendlier tools.

Better, friendlier tools are beginning to appear, and *TGS* is one of them.

I did not want to rush into a review of *The Graphic Solution*, or *TGS* as its makers call it. I wanted to take the time to familiarize myself with the product, learn its various techniques and features, and report my findings only when I had acquired a bit of dexterity with the tools it provided.

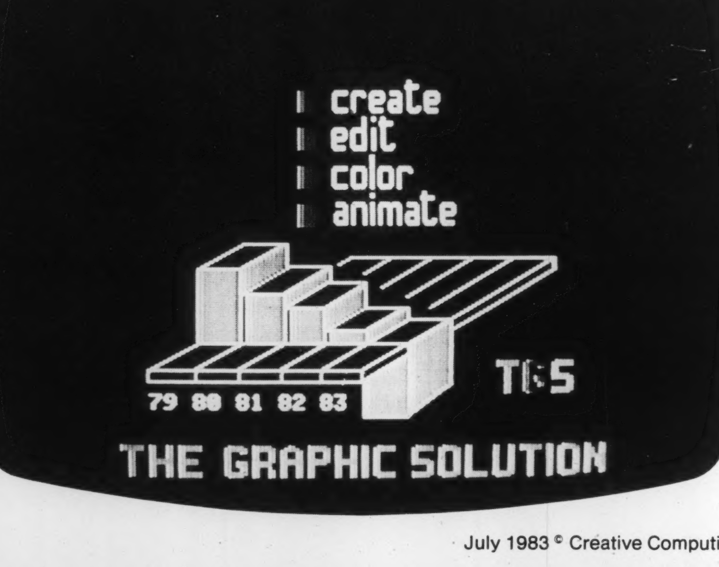
After having logged at least six hours or so of "flight time" with *TGS*, the time has come to report my findings. Although there are many maneuvers I have not yet mastered, I can do quite a bit more with an Apple using *TGS* now, than was previously possible for me from Basic, machine language, or any other graphics package. Besides, if I waited until I could do everything I wanted with it before I reviewed *TGS*, the review would never have happened.

To call *TGS* a graphics package is not incorrect, nor is it the whole truth. It is in fact a graphics *animation* package, with sophisticated capabilities to create and animate multiple, color shape tables on the screen. By developing sequences of "frames," the user is able to create his own animated "movie" programs on the Apple. The program and documentation use those very words to describe the animation process.

A preliminary caveat: while the program and documentation are well-designed and executed, *TGS* is the kind of package that demands a real commitment from the user in order to obtain real results. You must take the time, as I did, both to learn the tricks of the system, and then to manipulate those features effectively to create animated sequences. Unless you have the time and inclination to do so, *TGS* may disappoint you.

If on the other hand you do have both the time and the inclination, you will be well-rewarded. *TGS* is among the most powerful animation tools currently available for the Apple computer. After you have learned to use it, creating smooth, colorful animated graphics is, if not exactly easy, at least *possible* for those of us who have yet to master machine language.

In that respect, it is probably one of the programs you may have been waiting for: a system that will allow you to develop and store multiple shapes, then move them around the video screen according to your whim. The method it uses is straightforward yet ingenious. The main shape editing is done in lo-res, then transferred as a block to the point you choose on a hi-res screen. By fitting



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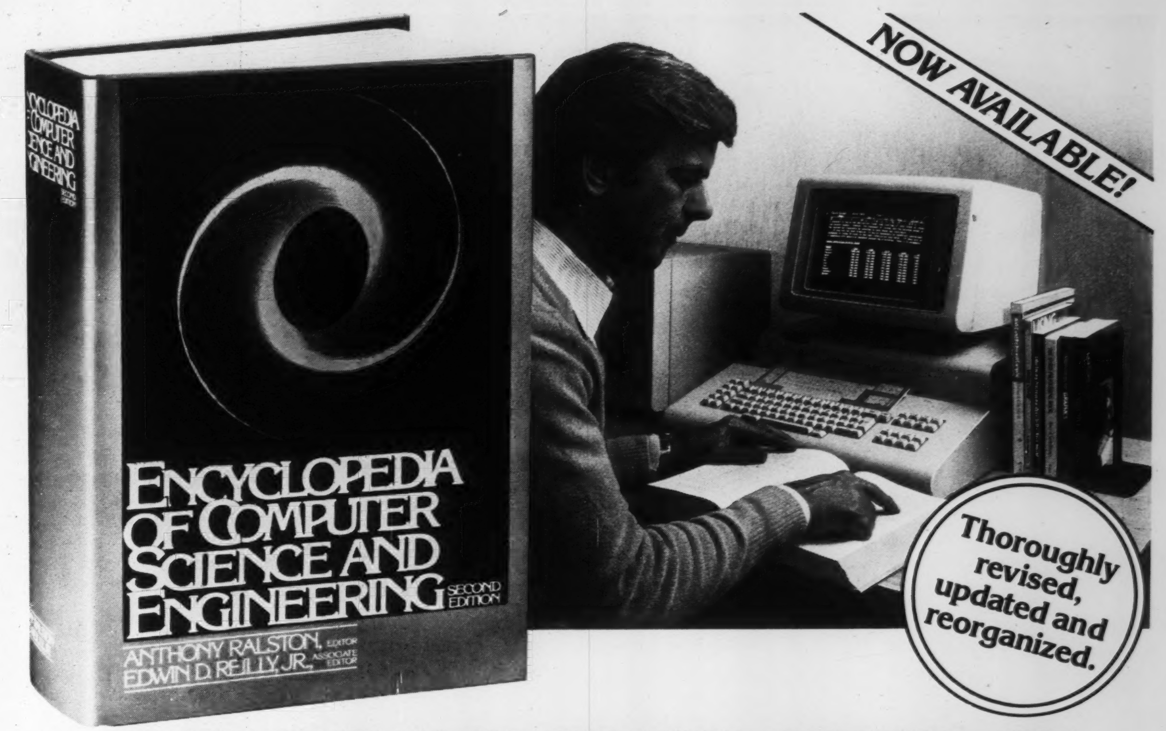
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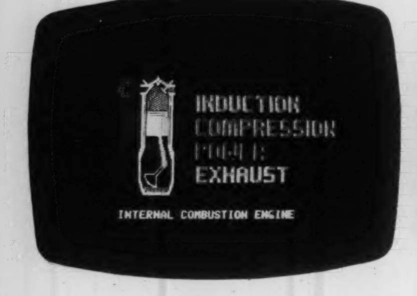
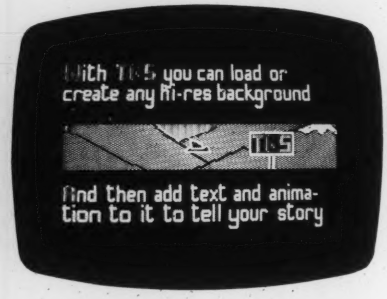



With TGS you can load or create any Hi-res background

And then add text and animation to it to tell your story

TGS
GRAPHICS THAT
REACH NEW HEIGHTS!

shapes together like a mosaic, you can create backgrounds, or animated images larger than the small hi-res window.

Drawing In Lo-Res

Drawing in the lo-res mode is extremely simple. The A key moves the cursor left, W moves it up, D moves it right, and X moves it down. The REPT key can be activated for quick-cursor movement. Depending on the mode of the cursor, which is controlled by the space bar, you can draw, erase, or move the cursor around a picture without changing it in any way. Other commands allow for erasing an entire block and cursor centering.

Type H, and you move from the lo-res to the hi-res mode. Instead of moving the cursor now, the movement keys move the entire hi-res window around the screen. A quick movement option can be invoked to get the hi-res window where you want it, then an incremental mode used to fine-tune movement. The text window at the bottom of the screen can be toggled off with the F key, freeing the entire screen area for graphics.

Here is where things start to happen. After positioning the hi-res window, typing P will copy the image in the lo-res screen to the hi-res window. You can choose whether to drop the contents of the window while retaining or erasing whatever is under the window position at the time. Thus, the user can create patterns of images from the window anywhere he wishes on the hi-res screen. This, combined with the capability of *TGS* to "snap frames" of screens and show them in quick succession, forms the essence of its bit-mapped animation.

creative computing

SOFTWARE PROFILE

Name: The Graphic Solution
Type: Animation graphics package
System: 48K Apple II
Format: Disk
Language: Machine
Summary: Complex but powerful graphics animation package.
Price: $149.95
Manufacturer:
Accent Software Inc.
3750 Wright Pl.
Palo Alto, CA 94306
(415) 856-6505

After moving the window in various ways about the screen for a while, the user will without doubt come to appreciate the potential to create *macros* within screen development. This means that repeated commands can be invoked by a single keystroke. Let's say you are moving a square from the lower left of the screen to the upper right. This calls for moving the window right, then up, then dropping the lo-res screen to hi-res, then repeating the process. Press CONTROL-R to signify the construction of a macro. Then move the window right, and up, and copy the window image. Press CONTROL-R again to end the macro. Now press R to execute the macro repeatedly, automatically moving and copying the picture. Although *TGS* allows definition of only one macro, that macro can contain up to 255 keystrokes, which is more than you will ever need. Thoughtful use of macros can save an immense amount of time and bother, and is heartily recommended.

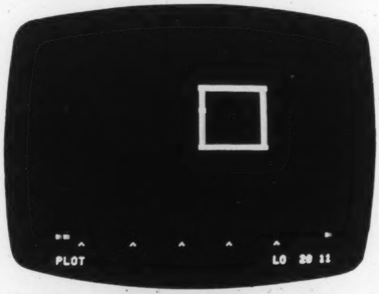
By placing the hi-res window anywhere on the screen, the contents of the window can be copied to lo-res. This means that window shapes need not necessarily be formed from the lo-res mode. Conversely, alterations in hi-res screens can be made by dropping portions into lo-res windows, altering, then replacing them.

Hi-Res Shapes

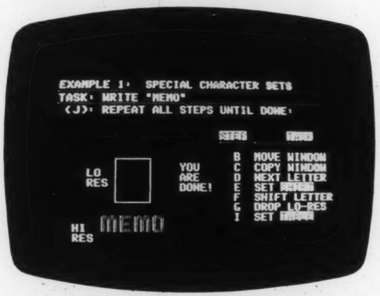
And I haven't even begun to get to the good stuff. Multiple hi-res window shapes can be saved to memory, then recalled as desired. This is the preferred means by which to save backgrounds (though whole screens can be saved through an alternative, memory-hungry method), and more importantly, constitutes an important animation tool. With the command +, *TGS* automatically creates tables for multiple user shapes, which can then be plotted on the screen by positioning the window and pressing the ; key (on the Apple a lowercase +). Plotting shapes in this way is much faster than dropping screens from lo-res, as described above. And *TGS* can store *dozens* of shapes.

None of this would be worth a heck of a lot without the ability to put "frames" of graphics together, and this is where the real power of *TGS* lies. By typing CONTROL-Z, you "shoot a frame" consisting of the current hi-res screen. The documentation actively uses the analogy of making a film through the process of amassing frames.

For simple animation, you don't need to know much more. Using the commands described above, you can create simple shapes and move them smoothly around the screen. To view them from within the *TGS* editor, hit the spacebar



The lo-res drawing mode.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TASK: WRITE "MEMO"
(J): REPEAT ALL STEPS UNTIL DONE:

B MOVE WINDOW
C COPY WINDOW
D NEXT LETTER
E SET
F SHIFT LETTER
G DROP LO-RES
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to enter the "show mode." From there, you can view your "film" as many times as you like by pressing the M key. Pressing any key during a show stops projection, which can then be advanced by the single frame in either direction. In this way you can inspect your work as closely as you wish. You can even tag frames with the command CONTROL-K, for later tune-up or modification, or to project the film from that specific point.

The rate of projection affects the speed with which animated objects appear to move. Using the speed command (S), the timing value for a segment of *TGS* animation can be easily set. All the user needs to do is reset the timing values wherever necessary, and *TGS* will remember to project each sequence at its assigned speed.

The only hitch with this feature is that timing values must be entered in *hexadecimal* increments of eight. This may be a bit bothersome at first, but is not too difficult to master.

Once you have a sequence you want to hold on to, you back-up to the program menu and select option 3 to save. To erase sequences, the three keys SHIFT, CONTROL, and @ must be pressed simultaneously, twice. It is therefore unlikely that you will delete anything accidentally.

The actual pixels used in Apple lo-res and hi-res differ in shape, so images created in lo-res seem compressed horizontally when viewed in hi-res. Elongation and compression commands are included in *TGS* to overcome this. Using them, lo-res images can be stretched or shortened—altered horizontally or vertically, using the keys B and V. These editing capabilities can do more than mere correction of lo-res to hi-res pixel distortion, of course. They can lengthen or shorten character sets and other graphic material.

> **Commands are available to allow drawing directly onto the hi-res screen, and to draw perfect circles without fuss or muss.**

Likewise, entire shapes can be scrolled horizontally or vertically in the hi-res window. This capability is exploited to create smooth animation of shapes smaller than the hi-res window. In addition, you can create mirror images with the command CONTROL-F. This is handy for creating symmetrical shapes.

Commands are also available to allow drawing directly onto the hi-res screen, and to draw perfect circles without fuss or muss.

Text

TGS can put text on the screen in two distinct ways. By using CONTROL-T to enter the text mode, a hybrid (and improved) version of the standard Apple character set is at your disposal. Just position the cursor, then type. Inverse video is also available. To animate text, capture it as shapes in the hi-res window. Then animate as you would any other shapes. This method can also be used to display and animate "super" character sets (see photos). A special character set is included along with demonstration sequences in the *TGS* package. As stated above, elongation and compression commands can be used to customize character sets.

Okay. Let's say you have created a sequence to use as an audio-visual aid at a business meeting. You need to save your sequences and a customized *projector* menu to a disk. You have the blessing of Accent Software, makers of *TGS*, to

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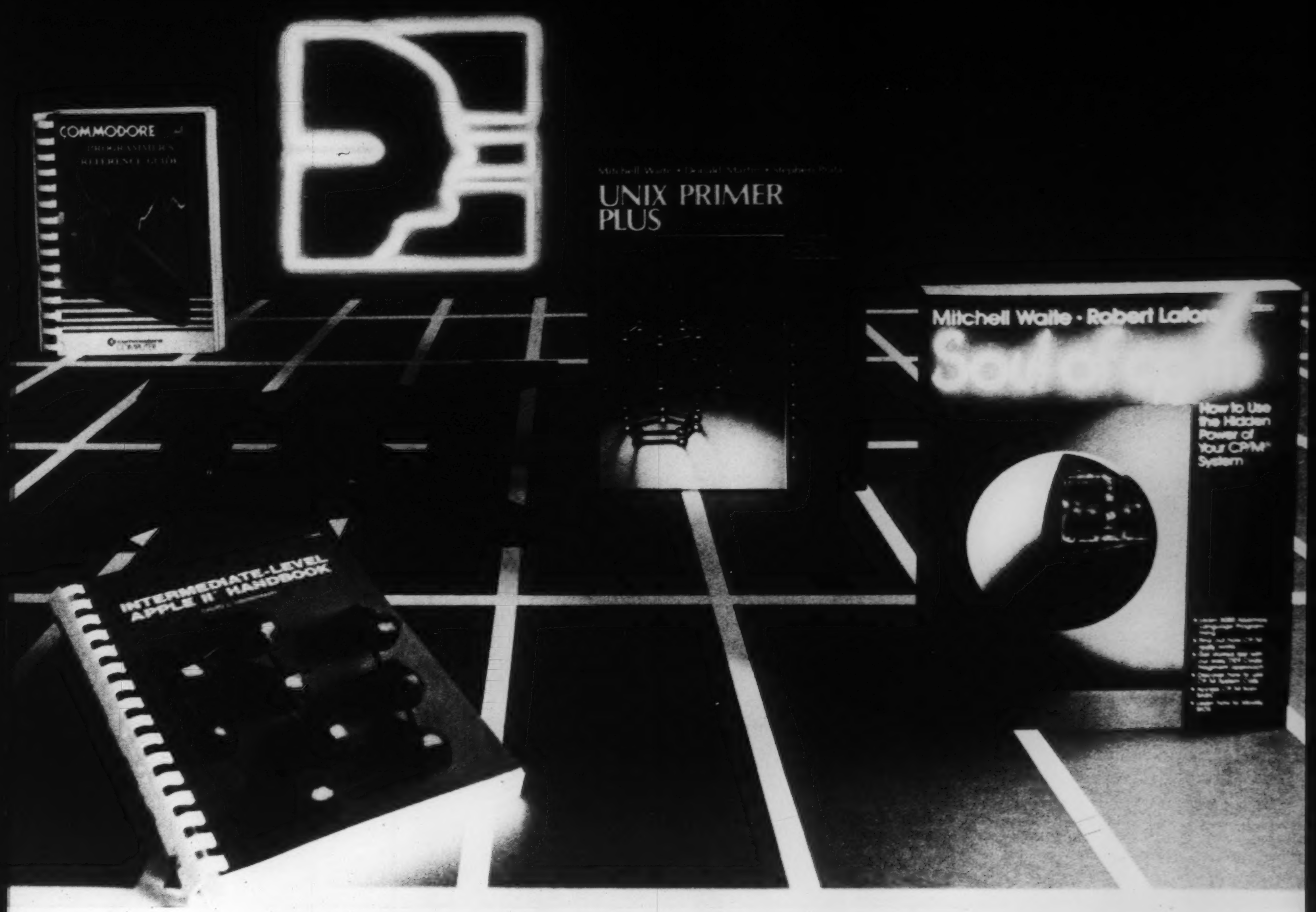
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make as many disks as you like for your own *noncommercial* purposes. If you wish to sell a disk that uses *TGS* techniques, however, you must have a special licensing agreement.

The documentation shows you how to create disks that will make *TGS* sequences autorun, and interface with Basic. Although you must have some knowledge of Basic to create sophisticated interfaces to *TGS* graphics (such as interactive tutorials and the like) extensive examples are provided in the documentation to lead the novice user through the process. In many simpler cases the programs can be entered with very little modification.

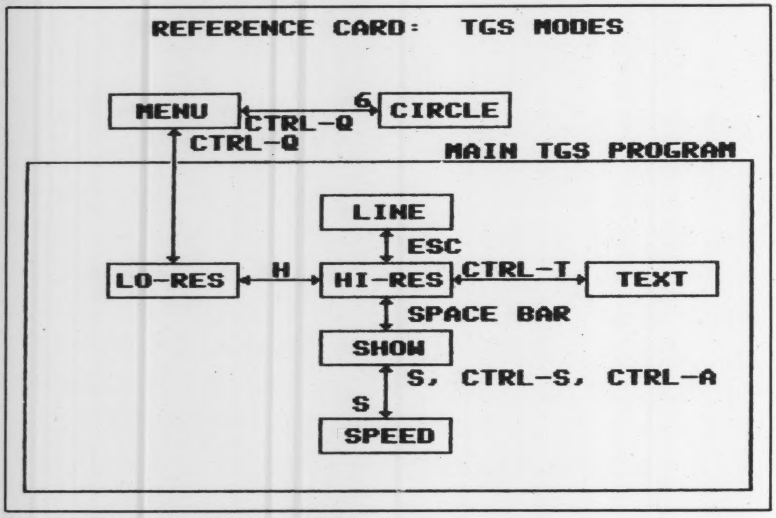

Figure 1. Program organization of TGS.

TGS does not have one of the simplest user interfaces you will find in an Apple graphics package. I'm sure that some folks will find it a bit too much for them—to learn cryptic command codes, create and effectively manage elaborate macros, manipulate machine language data files from Applesoft, and the like. The novice should be forewarned that *TGS* will pose a challenge. At the same time, dramatic results can be achieved with relatively little work, once the basic framework and concepts of the program are understood. The documentation is thorough, light-hearted, and includes reinforcement exercises at the end of each chapter. It makes the process of learning the *TGS* system much less tedious than it might otherwise be.

Advanced animation, using multiple shapes, colored backgrounds, shapes that cross each other, and complicated moving shapes, are the most challenging aspects of the *TGS* system. This is the area I am still working with now. I have come to realize that these kinds of advanced results will come only after I have spent more time with *TGS*. Though it is not the tool to bring animated graphics power to the masses, it is a substantial step in the right direction. As such I heartily recommend it. ☐

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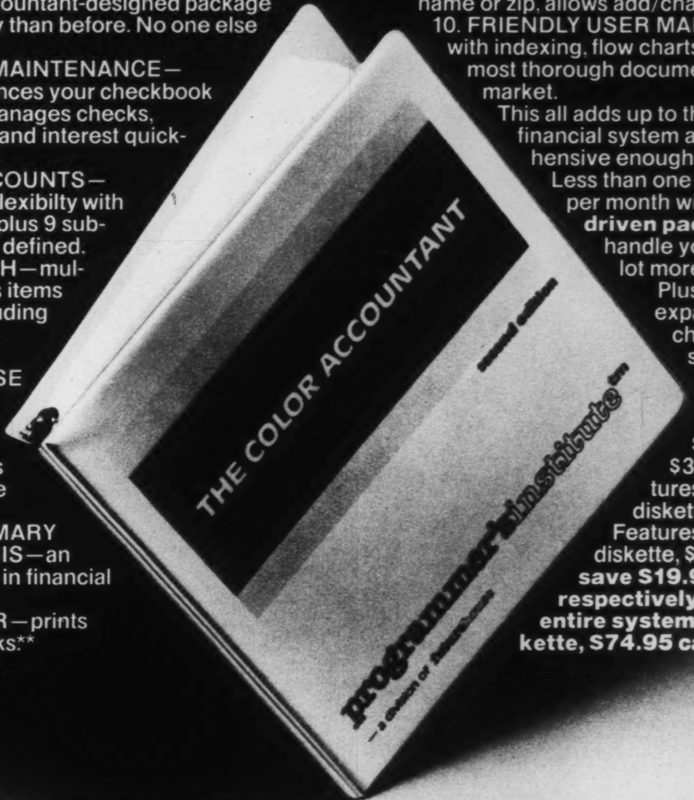

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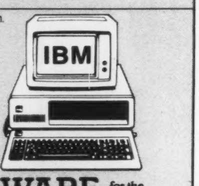

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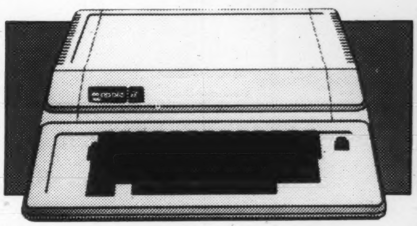

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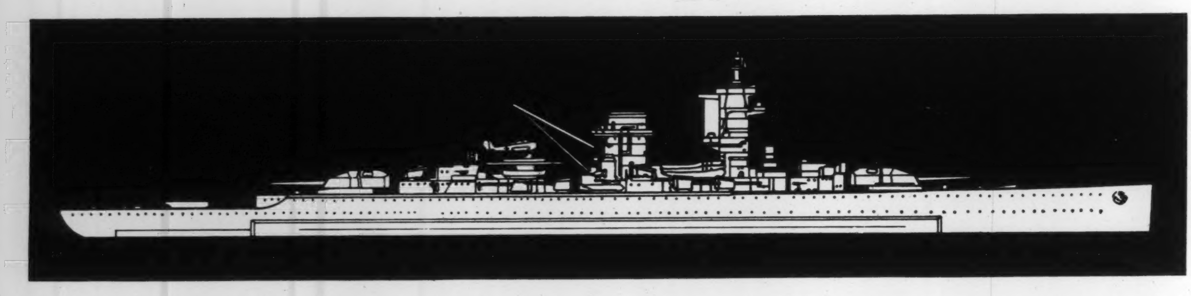
Warfare In The Atlantic



Brian J. Murphy

A desperate chase to find and destroy a deadly Nazi pocket battleship that is preying on Britain's South Atlantic shipping lifeline is the subject of a new Strategic Simulations wargame. *Pursuit of the Graf Spee* is a direct descendant of, and improvement on, SSI's original and classic wargame, *Computer Bismarck*.

This new game, created by Joel Billings (who assisted in the creation of *Computer Bismarck*), is substantially better than the earlier wargame, offering more excitement, more action and greater playability.

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SOFTWARE PROFILE

Name: Pursuit of the Graf Spee

Type: Warfare simulation

System: 48K Apple II with Applesoft ROM card or Apple II+, disk drive

Format: Disk

Language: Applesoft

Summary: Realistic, playable war game

Price: $59.95

Manufacturer:
Strategic Simulations Inc.
465 Fairchild Dr., Suite 108
Mountain View, CA 94043

The situation at the beginning of the game is as follows: It is December 1939, and the German pocket battleship Graf Spee and her auxiliary supply ship, Altmark, are in the South Atlantic, poised to strike at Allied merchant shipping off the coasts of West Africa and South America. The mission of the German player is simply to keep Graf Spee afloat, sinking British shipping and avoiding a fleet of Allied cruisers which are scouring the seas in search of her.

For the British player the situation is more difficult. The task is to locate and destroy the Graf Spee. Simple enough, but it could be hiding in any one of 232 sea squares on the hi-res color mapboard. On the first move each player knows the locations of the other's ships, but the Graf Spee will only be found again if a British ship winds up in the same square, or if it is sighted by a merchantman.

The British player has twelve ships with which to search, but their capabilities are limited. Primarily the problem is fuel. The ships use up to one fuel point for a day move and three for a night move. If you send your ships after Graf Spee in a hurry, it will cost a lot of fuel. Once you have expended your fuel points, your ship is restricted to daytime movement only.

In the meantime the German player, though in the dark about the exact locations of the Allied ships, has a much freer hand. When he runs low on oil, he can simply rendezvous with the Altmark and fill right up again. The British ships must head for one of five friendly ports to refuel, and only one of those ports is on the South American side of the map. In short, the German player has a big advantage which greatly enhances his mobility, speed and ability to dodge searchers. It is the same advantage that the real-life commander of the Graf Spee, captain Hans Langdorf, enjoyed.

While the British player sends his ships to and fro searching, the German sends Graf Spee into the shipping lanes—marked on the hi-res screen by white dots—where he will encounter Allied merchant ships if he hovers around in the patrol mode. When Graf Spee finds a merchant ship to sink, the computer automatically scores it as destroyed and awards victory points to the German player. A British merchantman can be worth up to 15 victory points. A German merchant ship—and there are a few on the board—is automatically sunk once sighted and 10 points are awarded to the British. At the end of the game the points are counted to determine the winner.

When opposing units find each other,

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the game goes into the tactical mode. The hi-res color map disappears, and you see a black screen. Letter codes for the ships are all that is displayed, with a G for Graf Spee always in the center. As you move the ships, the letters for the British ships will move, indicating their positions relative to Graf Spee. Below is a text window where information on range and course for the various ships is displayed and commands are entered.

In the tactical mode, players may maneuver ships, aim fore and aft turrets independently and fire torpedoes. The results of firing are displayed after both sides have entered their moves. If the ships wander out of range of each other (this is determined by visibility factors) then the ships are declared disengaged by the computer and the search resumes on the hi-res map. If the ships inflict damage on each other but do not sink prior to disengagement, then victory points are awarded for the damage.

Some care has been taken to make this game realistic, although some of the detail which made *Computer Bismarck* so realistic has apparently been sacrificed to make room on the disk for a tactical combat phase.

In taking hits, the Graf Spee has the advantage. At long range, when the computer Graf Spee is pounding the British effectively, shells hitting her tend to explode harmlessly on the deck plate or on the armor belt girdling the hull. Still, a lucky hit could disable one of Graf Spee's turrets or her rudder, but the British player risks losing a cruiser and from 40 to 100 victory points.

It is not easy, but the British player can win by accurately guessing the next German move and sending strong forces, especially Cumberland and Renown, after the Graf Spee. Once they find her, the best chance of winning in combat is to, again, try to anticipate Graf Spee's maneuvers and to attack her from two or more sides, if you have enough ships.

The game is heavily weighted in favor of the German player.

The game is heavily weighted in favor of the German player; almost any strategy will work for him. Good ideas are to keep Altmark handy and hidden. Refuel from her, but not in a neutral port. That automatically tips off the British, and you risk the possibility of the computer deciding, during your first visit, to scuttle your ship. Avoid points where the British are likely to wait for you. Hit the shipping lanes and run for it.

Options for play offered in *Pursuit of the Graf Spee* include scenarios beginning on December 1, 1939 and on December 13, the day a squadron of British cruisers found the Graf Spee off Montevideo harbor. The second scenario picks up the game in the tactical mode, with the Graf Spee squaring off for combat with Exeter, Ajax, and Achilles. If you prefer, you can resolve combat off-line, using naval miniatures, then input the results into the computer. You can play *Graf Spee* with another wargamer or against the computer.

In summary, *Pursuit of the Graf Spee* is a realistic simulation of a World War II naval campaign. It offers plenty of options to allow you to tailor the game to your own taste. It is not a game for someone who has never played a warfare simulation before, but for those who have had even minimal experience and who like a challenge, *Pursuit of the Graf Spee* is a good bet. ☐

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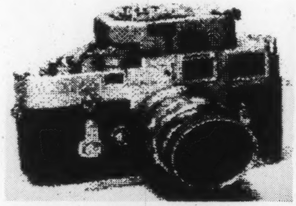

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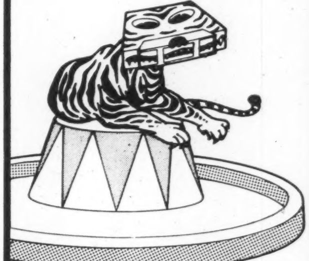

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CIRCLE 130 ON READER SERVICE CARD

Rapid Random Record Retrieval

C. A. Johnson

Practically everyone has a need for a good indexing program with efficient random searching capabilities at one time or another. There have been many times when I had a desperate requirement for such a program but did not have the time to write the program myself. My solution had been to build a text file with my word processing program and do my search and retrieval with the FIND command. It worked, but the limitations were severe, and it generally required that the data be entered manually from the keyboard.

When I encountered *Newtrieve* recently, I had mixed emotions. I was overjoyed that such a program was available and at the same time, skeptical of its flexibility. I now have several applications using it and I am just overjoyed.

Newtrieve is delivered on a single, 35-track disk, with no operating system. It consists of the demonstration program, NT/DEM; an enhancement subprogram, ENHAN/BAS; and two indexes, INDEXA/LM and INDEXB/LM. The hardware specified is a 48K TRS-80 Model I or III with one disk drive. The manual makes the point that two drives greatly expand the capability of the program, but it does not tell you how to copy the programs onto a disk with an operating system if you are using TRSDOS and one drive.

Minor modifications must be made to the demonstration program to make it compatible with the operating systems for Model I TRSDOS, Model III TRSDOS, or NEWDOS/80. All of the statements needed are already in the program, but are REM statements. The proper statements are made active by editing out the REM portion of those statements.

Although it does not purport to do everything, *Newtrieve* is an indexing algorithm with sufficient flexibility to enable it to handle a multitude of different applications.

As delivered, *Newtrieve* consists of two parts, the index and a Basic demonstration program which references the index by USR routines. The index provided is preformatted to 500 strings of 40 characters each. Other indexes are available from the manufacturer.

creative computing

SOFTWARE PROFILE

Name: Newtrieve

Type: Index retrieval database

System: TRS-80 Model I, III, 48K

Format: Disk

Summary: An innovative approach to index searching

Price: $75

Manufacturer:
Unique Printing & Stationery
11 Maiden Lane
New York, NY 10038

To get the most from the package, you need a knowledge of one of the operating systems and Basic programming. *Newtrieve* is designed as a programming tool, making it the basis of program development, but it can be used as delivered. The demonstration program is menu driven, but does not demonstrate the full capability of *Newtrieve.* The use of alternate indexes and alternate Basic programs is not included in the demonstration program. However, the documentation describes their use and gives some clues for expanding the system accordingly.

Included is a subprogram to enhance the demonstration program. The enhancement adds the ability to add a new search string immediately if a match is not found and to add data into the key string to further limit the search. It appears that the enhancement program was not included as much for actual enhancement as to provide an example for those who wish to make modifications of their own.

Using The Indexes

Indexes can be created interactively, from the keyboard, or loaded from an existing data file, using a modification of one of the subroutines included in the demonstration program.

Once an index has been created, it may be modified by selecting the line to be changed and entering the new data.

Searching the index is both simple and

C. A. Johnson, 3619 Sugarhill Dr., San Antonio, TX 78230.

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rapid. Enter the string or a subset of the string (key string) and *Newtrieve* will display all strings which contain the key entered. For example, STE will locate occurrences of SYSTEM, MASTER, and STERILE. By your choice it will display all occurrences at once, the first occurrence, or, if you have added the program which enhances the demonstration, one at a time as you press the ENTER key. Searching the entire index of 20,000 characters takes about one second.

If a search string returns too many data entries, it can be further limited with the Exclude feature. Entering E sets the exclusion flag and causes the program to request a string to be used to exclude strings. For example, STE with the exclusion of MA would return SYSTEM and STERILE in the example above, excluding MASTER.

Another feature provided is the ability to "browse" through the index. You may start at any index entry and browse in either direction, stop when you wish, change direction, continue, or return to the menu.

Included in the menu is the option to divide the index into two equal parts. Either half may then be searched individually. This is a nice feature which allows the inclusion of two short indexes or of two indexes which may be conceptually linked, as in an inventory system in which the first part of the index might be used to determine the part number from a description and the second part of the index to provide the number of items on hand, minimum quantity before ordering, wholesale cost, and retail price.

The program is exited by entering a 0.

Indexes can be created interactively, from the keyboard, or loaded from an existing data file.

If any changes have been made to the index being used, the program reminds you and asks if you wish to save the index. If you do, you select the proper option and the program branches to the "dump" routine. The one thing I found in *Newtrieve* which did not work on my machine was the "dump" routine. However, keying a suggested sequence under DOS accomplished a successful copy of the new index to replace the old one.

The documentation is, in general, very well done. The beginner may find much of it a bit too technical, but he will find enough that he can use immediately that he will probably not feel left out. As he gains experience with his computer, operating system, and Basic programming, he will appreciate the ability to use *Newtrieve* to expand his use of his system.

Spelling Errors

I do not understand why a software publisher will strive to produce a quality program and not take the time or trouble to eliminate spelling errors. The *Newtrieve* documentation has quite a few such errors, both in its internal documentation and in the printed manual. Such carelessness makes me uneasy with the program until I have satisfied myself that the same carelessness does not permeate the program as well.

I have not as yet pushed *Newtrieve* to the limit of its capability, but I am impressed with what I have seen and I have several more applications already planned for it. It is definitely an innovative concept worthy of extensive exploration. ☐

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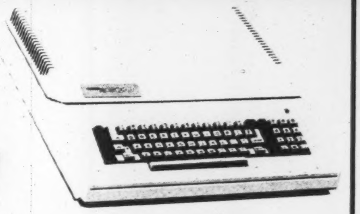

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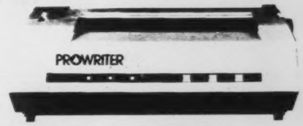

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Apple VisiCalc with a Joystick

Kraft Quik-Vis

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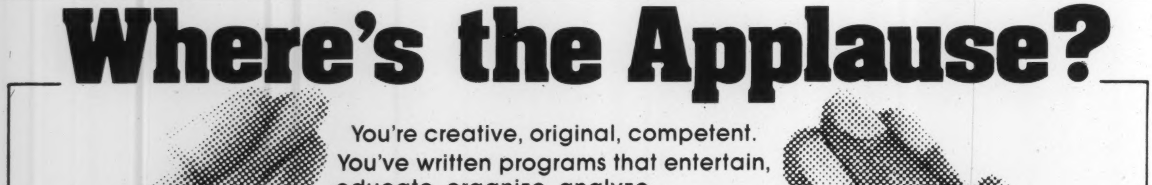
SOFTWARE PROFILE
Name: Quik-Vis
Type: Utility
System: Apple, joystick
Format: Disk
Summary: Moves VisiCalc cursor with a joystick
Price: $22.95
Manufacturer:
Kraft Systems Co.
450 W. California Ave.
Vista, CA 92083

David H. Ahl

Quik-Vis is a subroutine for use with the Apple computer and *VisiCalc* software package which allows the user to move the cursor around the screen with a joystick. There is not much more to say than that. Anyone who uses *VisiCalc* extensively on the Apple is probably fed up with the arrow/spacebar keypress combinations that have to be used for cursor movement. I certainly was, in fact, so much so that I quit using the Apple for *VisiCalc* and switched all of my *VisiCalc* work to a TRS-80 Model III.

Quik-Vis is booted prior to loading *VisiCalc*. Once loaded, you simply move the joystick handle in the direction you want the cursor to move. In addition, Button 0 moves the cursor immediately back to A-1, and Button 1 gives you extra-fast cursor speed.

For $22.95, no one who owns an Apple and *VisiCalc* should be without this handy product. ☐



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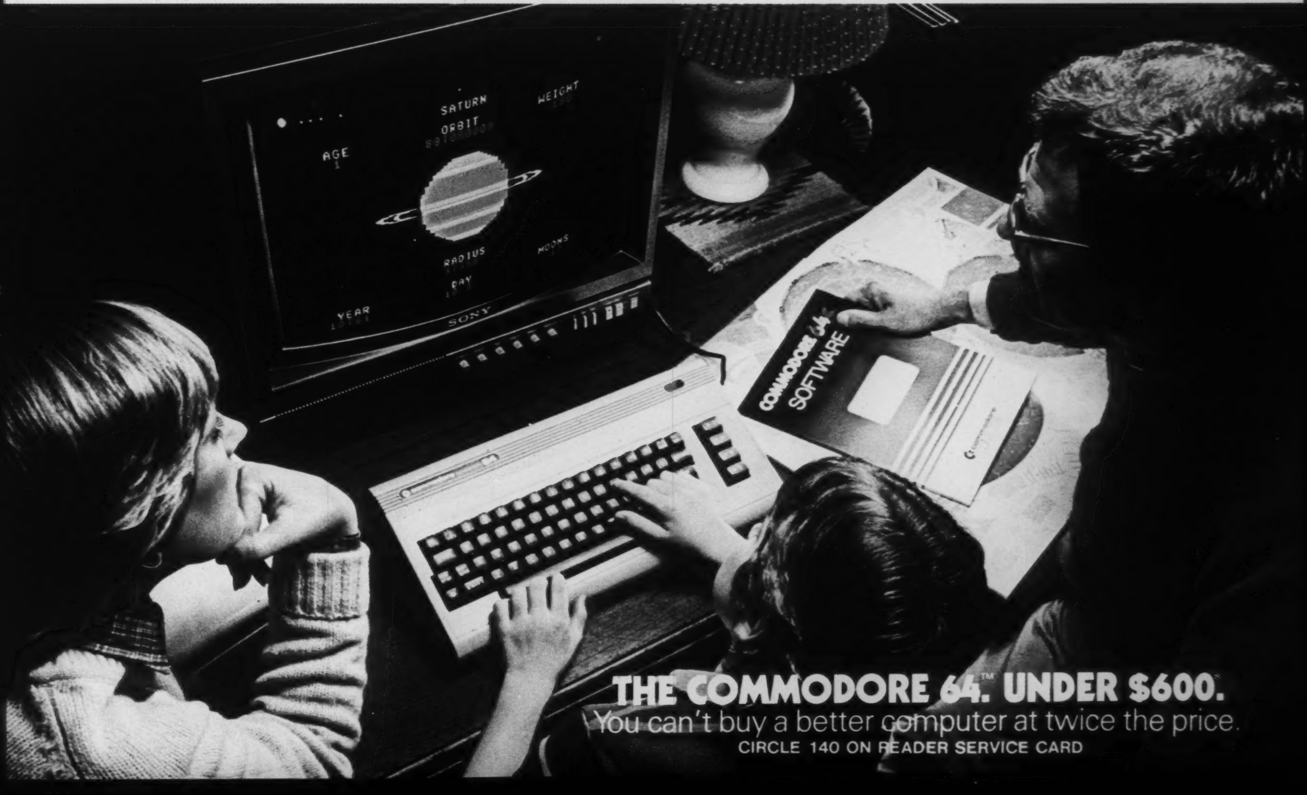

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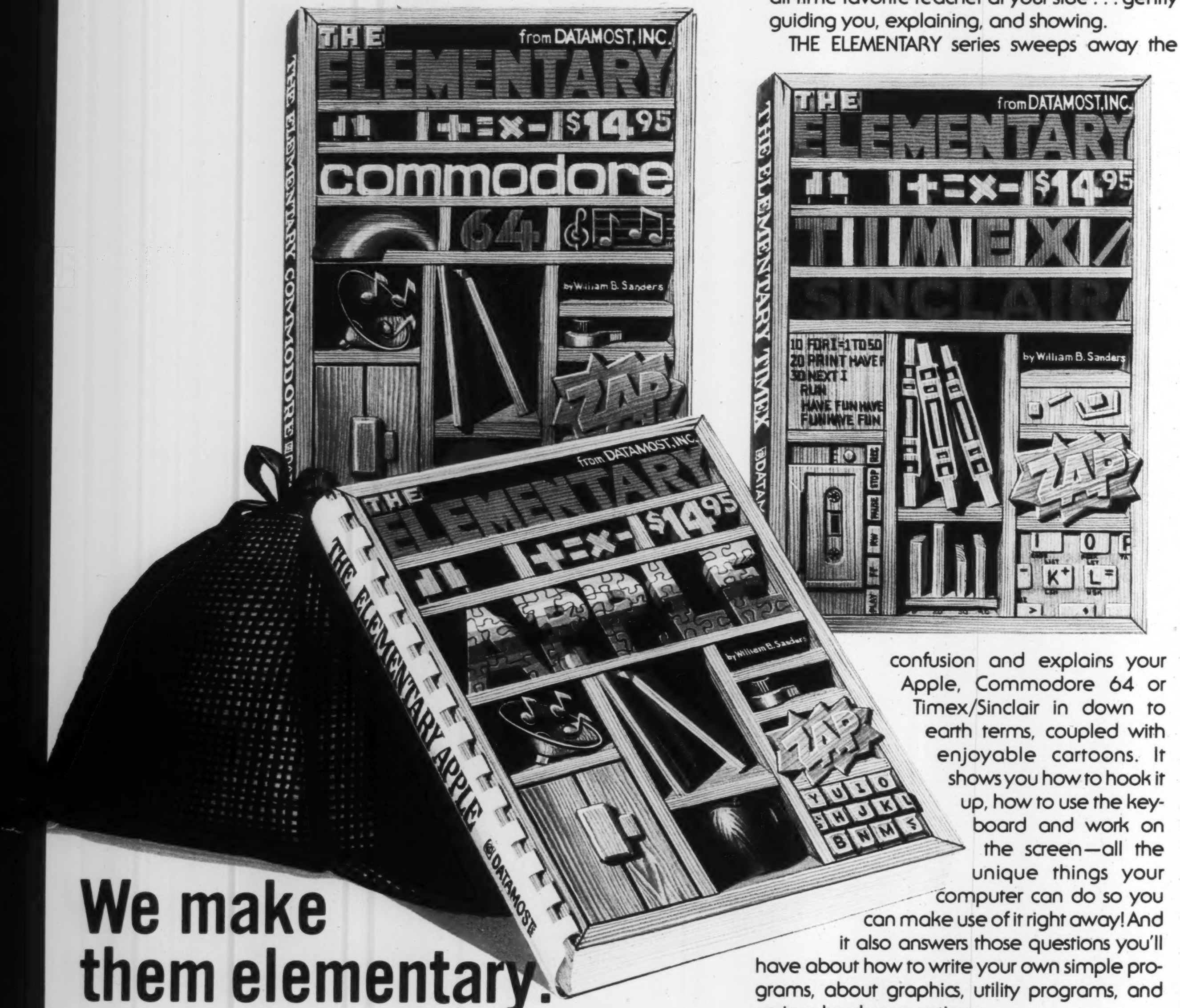
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CIRCLE 157 ON READER SERVICE CARD

The Transparent Sort

David H. Ahl

The Transparent Sort is an on-screen demonstration of the Shell/Metzner sort, an especially efficient sorting routine.

If you have read any of the articles in *Creative Computing* about sorting techniques, the Shell/Metzner sort has probably caught your eye as being fast and efficient. It is, but it is not all that easy to understand exactly how the speed and efficiency are achieved. *The Transparent Sort* will help.

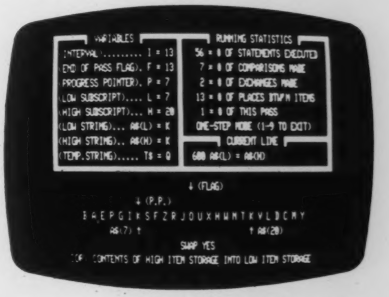
The 26 letters of the alphabet are shown across the bottom of the screen in one of five orders which you choose from a menu (in order, reversed, scrambled, random, or select your own order). Two lists appear above the alphabet; the one on the left shows the value of each variable in the program, while the other shows running statistics (statements executed, number of comparisons, etc.). Also shown is the current line of the program being executed and an explanation of the line.

When you start the program, two arrows, which point to the two values (letters) which the program is currently comparing, appear below the alphabet. A third "progress pointer" shows how far into the list the sort has progressed.

The program can be run at any of nine speeds by pressing a number key. Slow speeds are useful at first when you want to read the explanation of each statement, but the faster speeds are useful to demonstrate vividly how the list is progressively being brought into the sorted order.

For the most part, the 16-page manual is excellent, except for one exceptionally nasty mistake. In particular, the most important statement of the flowchart (the comparison of the two current values) has the "yes" and "no" reversed on the output arrows. A minor nit is that the authors use a rectangle symbol for a comparison, whereas a diamond is correct.

Given that the TRS-80 Model I is no longer on the market, we think that TRS-80 disk software packages should boot up on both the Models I and III. This one doesn't; to run it on a Model III, it must be converted. This is not a horribly onerous job, except that after conversion the on-screen arrows become right and left brackets which destroys some of the visual effect.



```
        VARIABLES                          RUNNING STATISTICS
(INTERVAL)......... I = 13       56 = # OF STATEMENTS EXECUTED
(END OF PASS FLAG). F = 13        7 = # OF COMPARISONS MADE
(PROGRESS POINTER). P = 7         2 = # OF EXCHANGES MADE
(LOW SUBSCRIPT).... L = 7        13 = # OF PLACES BTW'N ITEMS
(HIGH SUBSCRIPT)... H = 20        1 = # OF THIS PASS
(LOW STRING)... A$(L) = K        ONE-STEP MODE (1-9 TO EXIT)
(HIGH STRING).. A$(H) = K              CURRENT LINE
(TEMP.STRING)..... T$ = Q        600 A$(L) = A$(H)

                        ↓ (FLAG)
            ↓ (P.P.)
     B A E P G I K S F Z R J O U X H W N T K V L D C M Y
          A$(7) ↑                        ↑ A$(20)
                        SWAP YES
  COPY CONTENTS OF HIGH ITEM STORAGE INTO LOW ITEM STORAGE
```

The program has a non-transparent mode of operation to demonstrate the speed of the Shell/Metzner sort. Unfortunately, the fact that it will sort a mixed up alphabet in 8.3 seconds is a bit meaningless without another figure with which to compare it. We think the authors should have included a common bubble sort program on the disk or in the manual to better make the point on speed.

Despite our criticisms, we feel *The Transparent Sort* is an excellent introduction to a fast, efficient sorting technique. We hope that it will encourage more people to use the Shell/Metzner approach in their programs. ☐

creative computing

SOFTWARE PROFILE

Name: The Transparent Sort
Type: Educational demonstration
System: TRS-80 Models I, III
Format: Cassette or disk
Summary: Watch a sort in progress
Price: Cassette $14.95, Disk $19.95
Manufacturer:
Pulse Software Co.
P.O. Box 1086
Freehold Twp., NJ 07728

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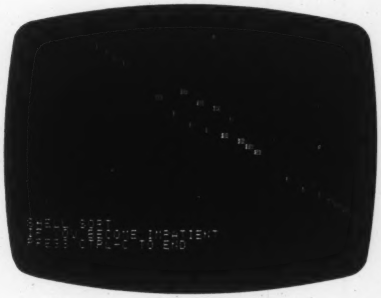
CIRCLE 284 ON READER SERVICE CARD

Lo-Res Sort Display

David G. Schwaegler

The program presented here is a visual aid to understanding various algorithms for sorting lists into rank order. The user may see the operation of the infamous Bubble Sort and the much more efficent Shell Sort in action. A place was left open in the menu to encourage the inclusion of other sorting routines. The low-resolution graphics capabilities of Applesoft are used, but the program could be adapted to machines without graphics by using PRINT, VTAB amd TAB statements in place of the PLOT statements.



```
SHELL SORT
IF YOU BECOME IMPATIENT
PRESS CTRL-C TO END
```

Program Operation

The program is generously REMarked to explain the specific line functions. Line 100 begins the routine which chooses data points. Each of the 40 points of the Apple screen horizontal (X) axis is assigned a vertical axis (Y) value. Line 130 checks to make certain that no two of these values are alike.

The job of the sorting algorithm is to rearrange those Y values so that they increase in value as the X values increase. Each interchange is shown on the screen using the subroutine at 40 for the Bubble Sort and at 45 for the Shell Sort. The SCRN (X,Y) statement in Applesoft returns the color of the square plotted by the coordinates in the argument. By using SCRN just before the plotting subroutines are called, the colors are preserved and assigned to the data points as they are placed in their new positions. This color coding of the points helps the viewer follow the action. The differences in speed and strategy of sorting routines are much clearer after viewing them while they work. ☐

David Schwaegler, Route 3, Box 362, Solon, IA 52333.

Lo-Res sort demo.

```
5  REM  REMOVE REMARKS FOR FASTER PROGRAM

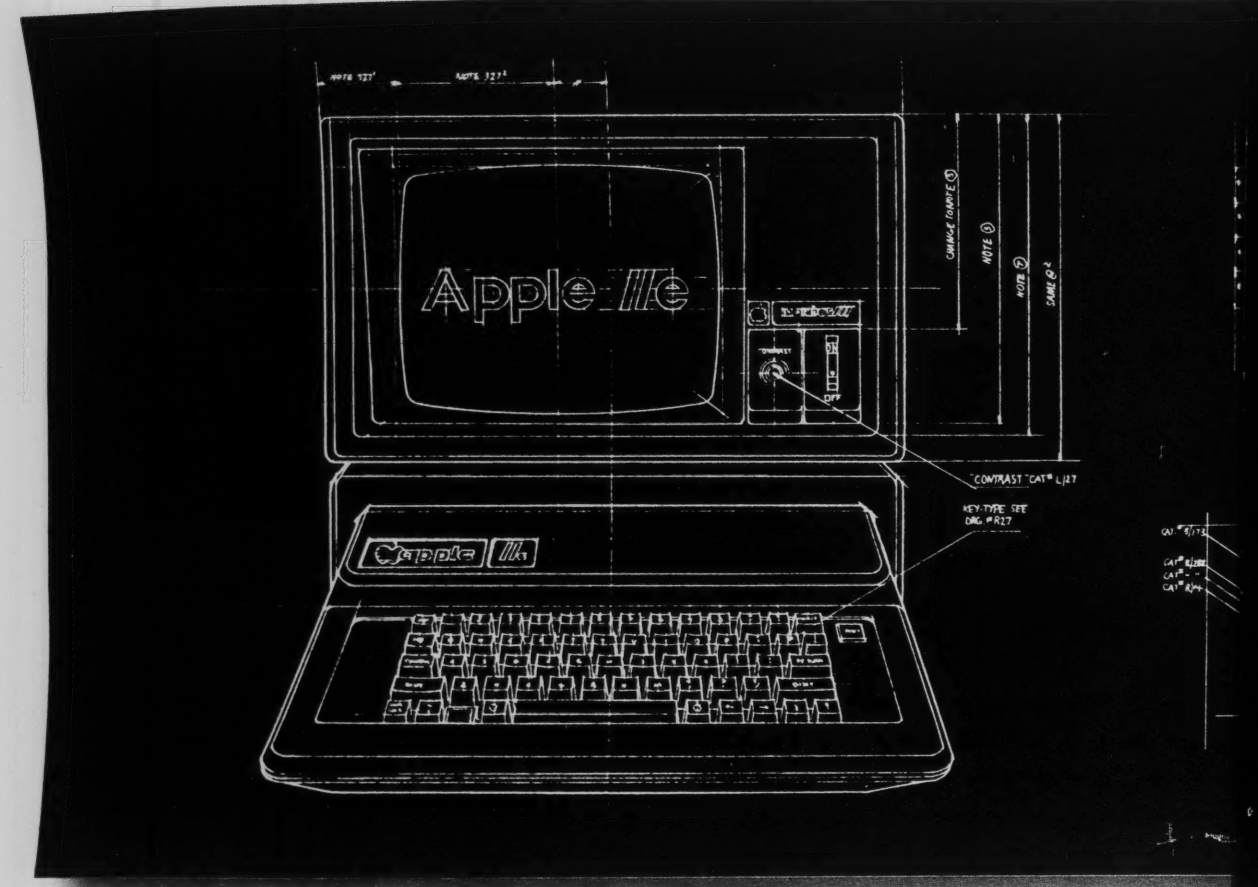

10  REM  LOWRES SORT DEMO


20  REM   by DAVID SCHWAEGLER   9/7/82


29  REM   CTRL-C LEADS TO MENU
30  ONERR  GOTO 60
35  GOTO 50
39  REM  COMMON SUBS NEAR TOP FOR BETTER SPEED
40  FOR Z = 0 TO 1: COLOR= CL%(Z): PLOT X + Z,S%(X + Z):
     NEXT : FOR Z = 1 TO TIME: NEXT : RETURN
45  COLOR= CL%(0): PLOT I,S%(I): COLOR= CL%(1): PLOT
     L,S%(L): FOR T = 1 TO TIME: NEXT : RETURN


49  REM  INITIALIZE
50  DIM C%(39),S%(39),TC%(1):CL%(1)
60  TEXT : HOME : VTAB 5: PRINT "THIS PROGRAM PROVIDES A
     SLOW MOTION": PRINT : PRINT "DISPLAY OF THE
     OPERATION": PRINT : PRINT "OF COMMON SORTING
     ALGORITHMS.": VTAB 12: PRINT "PRESS A KEY TO CONTINUE.
70  PRINT "PRESS 'ESC' TO END.": GET Q$: IF Q$ =  CHR$ (27)
     THEN  END
```

It's the same old Apple II.


NOTE 327¹
NOTE 327²
Apple //e
CHANGE TO NOTE ⑤
NOTE ③
NOTE ⑦
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ON
OFF
CONTRAST CAT# L/27
KEY-TYPE SEE DRG. #R27
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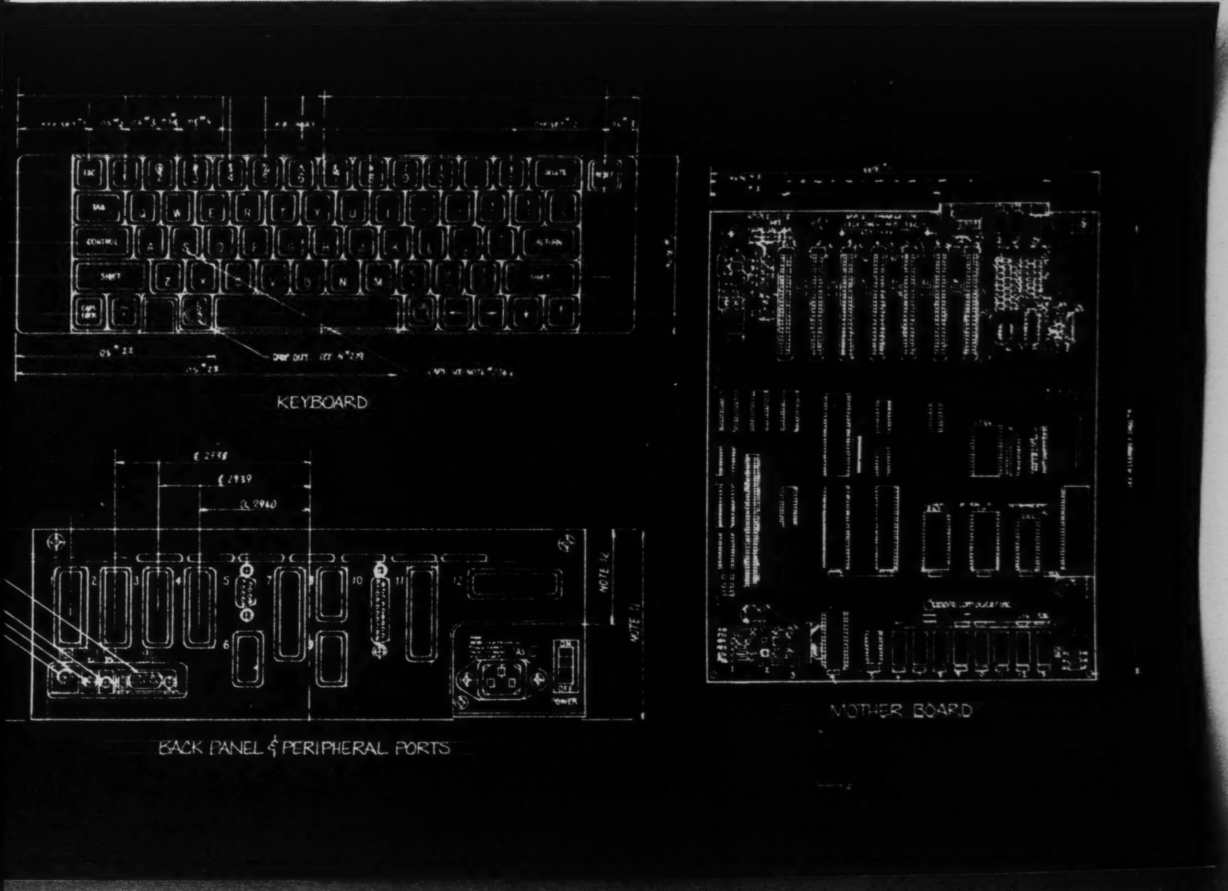

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CIRCLE 113 ON READER SERVICE CARD

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POWER For power—the ability to write better, clearer programs, faster—Pascal is the run-away winner. Example: JRT simplifies programming by accomplishing complicated operations (for Basic) with one command:

```
Basic                      JRT Pascal
IF A$ = "V" OR             IF A IN ['V'..'Z'] THEN...
   A$ = "W" OR
   A$ = "X" OR
   A$ = "Y" OR
   A$ = "Z" THEN...
```

FLEXIBILITY JRT's wide variety of data types reduces programming restrictions. And the data types are not all fixed in size. There are *3 looping statements* (Basic has 1). With JRT, very large programs can be created and run, because program modules can be spread over many diskettes. Common modules can be used for several programs. Basic generally limits strings to 255 bytes; *JRT strings go up to 64K.*

EFFICIENCY Whereas Basic relies on a static, inefficient memory map to allocate storage, JRT's *dynamic storage* fills every available main storage area; there's no waste. With Basic, sub-routine modules must be linked together; with JRT, they can be linked—but don't have to be. JRT's more powerful commands run faster; typically, you'll *write Pascal programs 3 to 10 times faster* than in Basic. *Exclusive:* JRT lets you directly access the CP/M* operating system for better total system control.

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Arithmetic precision	Usually 6 or 7 digits	14 digits
Indexed files	No	Yes
Maximum string size	255 characters	64,000 characters
Loop statements	1	3
Data types	Usually 2 or 3	12
CASE statement	No	Yes
Introduced	1965	1980
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- Statistic procedures
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CIRCLE 199 ON READER SERVICE CARD

Lo-Res Sort, continued...

```
80  HOME : VTAB 5: PRINT "FIRST, POINTS WILL BE PLOTTED":
     PRINT : PRINT "IN A RANDOM ORDER.": PRINT : PRINT :
     PRINT "THEN THEY WILL BE SORTED TO FORM": PRINT :
     PRINT "A DIAGONAL LINE.
85  PRINT : PRINT : PRINT "CHOOSE THE SPEED.  ENTER A
     NUMBER FROM": PRINT : PRINT "1 TO 1000 ( 1=FASTEST;
     1000=SLOWEST).": INPUT TIME$:TIME =  VAL (TIME$): IF
     TIME < 1 OR TIME > 1000 THEN 80
90  GR


99  REM   GENERATE ALL NUMBERS FROM 0 TO 39  IN A RANDOM
     ORDER
100  FOR X = 0 TO 39:C%(X) = 0: NEXT : REM    CHECK ARRAY
110 X = 0
120 D% =  INT ( RND (1) * 40)


129  REM  IF THIS POINT IS ALREADY USED, TRY AGAIN
130  IF C%(D%) = 1 THEN 120


139  REM  FOUND A WINNER
140 C%(D%) = 1:S%(X) = D%


149  REM   PICK A COLOR LINKED TO THE SIZE OF THE 'Y AXIS'
    VALUE AND PLOT THE POINT
150 CL% = D% / 4 + 1: COLOR= CL%: PLOT X,S%(X)


159  REM      CLEAR AWAY THE PREVIOUS MESS (PRINT SPC(40)
    WILL WORK INSTEAD OF THE CALL)
160  VTAB 22: HTAB 1: CALL  - 868


169  REM  REPORT ON PROGRESS
170  VTAB 22: PRINT "X AXIS ";X,"Y AXIS ";S%(X)
180  VTAB 23: PRINT "WORKING ON NUMBER ";X + 1
182  VTAB 24: CALL  - 868
185  VTAB 24: PRINT "COLOR=";CL%;

189  REM  GO BACK FOR ANOTHER
190 X = X + 1: IF X < 40 THEN 120


194  REM   LAST X NOT USED
195 X = X - 1


199  REM  ALLOW USER TO CHOOSE SORT
200  HOME : VTAB 21: PRINT "CHOOSE SORT ALGORITHM": PRINT
210  INVERSE : PRINT "B";: NORMAL : PRINT "UBBLE".: INVERSE
     : PRINT "S";: NORMAL : PRINT "HELL".: INVERSE : PRINT
     "Y";: NORMAL : PRINT "OURS
215  INVERSE : PRINT "Q";: NORMAL : PRINT "UIT";
220  GET Q$: IF Q$ = "B" THEN  GOSUB 300: GOTO 60
230  IF Q$ = "S" THEN  GOSUB 400: GOTO 60


239  REM  AFTER ANOTHER ROUTINE IS ADDED. CHANGE THE 'GOTO'
     IN LINE 240 TO 'GOTO 60'
240  IF Q$ = "Y" THEN  GOSUB 600: GOTO 200
250  IF Q$ = "Q" THEN  TEXT : HOME : END
260  GOTO 200


299  REM  BUBBLE SORT
300  HOME : VTAB 22: PRINT "BUBBLE SORT": PRINT "IF YOU
     BECOME IMPATIENT": PRINT "PRESS CTRL-C TO END
310  FOR Y = 0 TO 39: FOR X = 0 TO 38
320  IF S%(X) <  = S%(X + 1) THEN 360


329  REM     RE-ARRANGEMENT NEEDED SO SAVE COLORS OF POINTS
     AND ERASE OLD POSITION
330  FOR Z = 0 TO 1:TC%(Z) =  SCRN( X + Z,S%(X + Z)): NEXT
335  FOR Z = 0 TO 1:CL%(Z) = 0: NEXT : GOSUB 40: REM
     ERASE WITH BLACK


339  REM   SWITCH
340 TEMP% = S%(X):S%(X) = S%(X + 1):S%(X + 1) = TEMP%


349  REM   PLOT NEW POSITION
350 CL%(0) = TC%(1):CL%(1) = TC%(0): GOSUB 40: REM
     RESTORE COLOR TO POINTS IN NEW POSITIONS
360  NEXT
370  NEXT


379  REM  SIGNAL COMPLETION
380  HOME : PRINT  CHR$ (7): VTAB 22: PRINT "PRESS KEY TO
     RETURN TO MENU"
```

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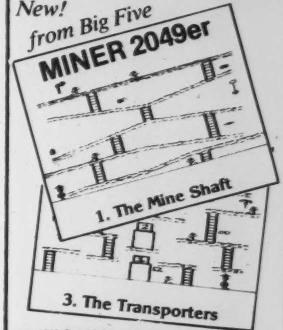

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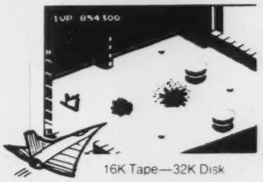

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CIRCLE 245 ON READER SERVICE CARD

Lo-Res Sort, continued...

```
390  GET Q$: RETURN


399  REM  SHELL SORT
400 M = X: HOME : VTAB 22: PRINT "SHELL SORT": PRINT "IF
     YOU BECOME IMPATIENT": PRINT "PRESS CTRL-C TO END"
410 M =  INT (M / 2)
415  IF M = 0 THEN 540: REM   FINISHED
420 K = X - M
430 J = 0
435 I = J
440 L = I + M
450  IF S%(I) <  = S%(L) THEN 510


459  REM   SWITCH NEEDED.  SAVE COLORS OF POINTS
460 TC%(0) =  SCRN( I,S%(I)):TC%(1) =  SCRN( L,S%(L)): FOR
     Z = 0 TO 1:CL%(Z) = 0: NEXT : GOSUB 45: REM    SAVE
     COLORS AND ERASE WITH BLACK
470 TEMP% = S%(I):S%(I) = S%(L):S%(L) = TEMP%
480 CL%(0) = TC%(1):CL%(1) = TC%(0): GOSUB 45: REM   PLOT
     NEW POINT
490 I = I - M
500  IF I >  = 0 THEN 440
510 J = J + 1
520  IF J > K THEN 410
530  GOTO 435


539  REM   SIGNAL COMPLETION
540  HOME : PRINT  CHR$ (7): VTAB 22: PRINT "PRESS A KEY TO
     RETURN TO MENU"
550  GET Q$: RETURN


600  REM  PLACE FOR ANOTHER
610  HOME : VTAB 22: PRINT "NO SORT INSTALLED HERE YET"
620  PRINT "PRESS ANY KEY TO RETURN TO MENU"
630  GET Q$: RETURN


1000  REM  VARIABLE ATLAS


1001  REM    C%(ARRAY) = CHECK ARRAY FOR RANDOM NUMBER;0 =
     UNUSED;1 = USED


1002  REM   S%(ARRAY) = THE DATA  FOR SORTING; ALSO USED TO
     DETERMINE THE 'Y AXIS'

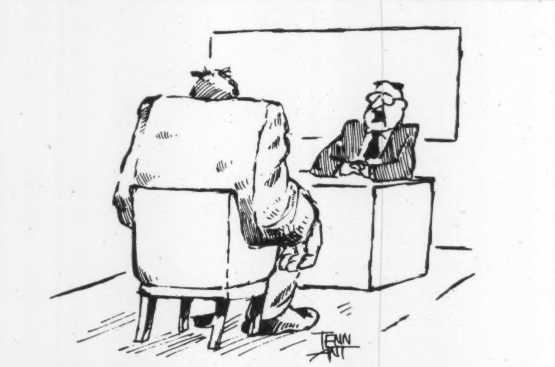

1003  REM   CL% AND CL%(ARRAY) = COLORS FOR  PLOTTING


1004  REM   TC%(ARRAY) = TEMPORARY COLOR .  USED TO SAVE
     THE COLOR OF THE POINT WHILE IT IS MOVED


1005  REM  X='X AXIS'


1006  REM   OTHER VARIABLES ARE SCRATCH VARIABLES


1007  REM  CODING AND VARIBLES TAKE LESS THAN 4K OF RAM
```



"We need someone who'll go to the users' group meetings to break some pirates' knuckles."

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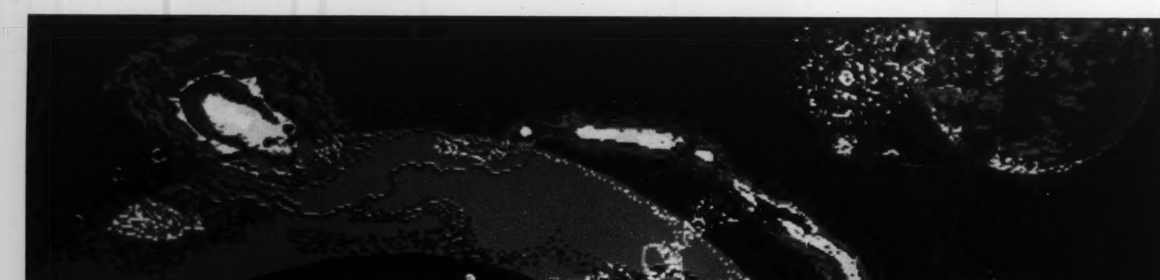
CIRCLE 200 ON READER SERVICE CARD

Saul Bernstein: Pixel Picasso

John J. Anderson

Saul Bernstein is without a doubt the top microcomputer artist in the country today. He has gained nationwide notoriety and acclaim, and won an Emmy for his efforts in microcomputerized animation. Though it is less well known, he is also one of the most eloquent voices speaking for microcomputers in education that you are apt to hear.

When the Royal Family visited Silicon Valley a few months ago, it was Saul who was commissioned by Hewlett-Packard to do portraits of Queen Elizabeth and Prince Phillip. They were so striking that the Queen thought the computer images had somehow been produced photographically, until she was told Bernstein works



From the realm of the microcomputer: an image at once cosmic yet human. When viewed on a CRT, evocative of stained glass.

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deals for July!

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TITLE	RETAIL	COST
Hi-Res Computer Golf	$ 34.95	$ 25.95
Choplifter	34.95	25.95
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Gumball (New)	29.95	21.95
Home Accountant	74.95	54.95
R.E.I.P. (Real Estate)	129.95	96.95
Property Manager	295.00	221.95
Market Technician (New)	195.00	144.95
GL W/Payables	495.00	369.95
Payroll	395.00	289.95
Receivables (New)	395.00	289.95
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PSAT	49.95	36.95
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Castle Wolfenstein	29.95	21.95
Caverns of Freitag (New)	29.95	21.95
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Repton	39.95	29.95
Wizardry	49.95	36.95
Knight of Diamonds	34.95	25.95
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Battle Cry (New)	32.95	23.95
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Zork 3	39.95	29.95
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ATARI

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Serpentine (Rom Cart)	44.95	33.95
A.E. (New) (D)	34.95	25.95
Bank Street Writer (New)(D)	69.95	52.95
Air Strike (T)	39.95	29.95
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Zaxxon (T/D)	39.95	29.95
Temple of Apshai (T/D)	39.95	29.95
Jumpman (New) (T/D)	39.95	29.95
Starbowl Football (T/D)	32.95	24.95
Zork 1 (D)	39.95	29.95
Zork 2 (D)	39.95	29.95
Zork 3 (D)	39.95	29.95
Deadline (D)	49.95	36.95
Starcross (D)	39.95	29.95
Suspended (New) (D)	49.95	36.95
MasterType (D)	39.95	29.95
Castle Wolfenstein (D)	29.95	21.95
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Martian Raider (New) (T)	19.95	14.95
Shark Trap (New) (T)	19.95	14.95
Choplifter (SAVE!!!) (C)	44.95	29.95
Rat Hotel (New) (C)	39.95	29.95
Trashman (SAVE!!!) (C)	44.95	29.95
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Sword of Fargoal (T)	29.95	21.95
Rescue at Rigel (T)	29.95	21.95
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Quick Brown Fox (C)	65.00	48.95
Deadly Duck (C)	34.95	25.95
Touch Typing Tutor (T)	19.95	14.95
Annihilator (T)	19.95	14.95
Kongo Kong (T)	19.95	14.95
Trek (T)	19.95	14.95
Flash 'N Math Addition (T)	15.95	11.95
Flash 'N Spell (T)	15.95	11.95
Serpentine (SAVE!!!) (C)	44.95	29.95

COMMODORE 64

TITLE	RETAIL	COST
Home Accountant (D)	74.95	54.95
Temple of Apshai (D)	39.95	29.95
Upper Reaches of Apshai (D)	19.95	14.95
Curse of Ra (D)	19.95	14.95
Jumpman (New...GREAT!)(D)	39.95	29.95
Coco (D)	49.95	36.95
Gridrunner (C)	39.95	29.95
HES Writer (C)	44.95	34.95
Retro Ball (C)	39.95	29.95
HES Mon 64 (C)	39.95	29.95
Zork 1 (D)	39.95	29.95
Zork 2 (D)	39.95	29.95
Zork 3 (D)	39.95	29.95
Deadline (D)	49.95	36.95
Starcross (D)	39.95	29.95
Suspended (New) (D)	49.95	36.95
Weather War II (T)	19.95	14.95
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Wall Street (D/T)	24.95	18.95
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Data Manager (D/T)	24.95	18.95
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Adventure Pack 2 (T)	19.95	14.95
Grave Robbers (T)	19.95	14.95
Trek-64 (T)	15.95	12.95
Annihilator (T)	21.95	15.95
Kongo Kong (T)	24.95	18.95

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Budget Master (T)	15.95	12.95
Reversi (T)	15.95	12.95
2K Trek (T)	15.95	12.95
Sabotage (T)	15.95	12.95
2K Fun Pack (T)	15.95	12.95
Gulper (T)	15.95	12.95
Astro 100-0 (T)	15.95	12.95
Cosmic Invaders (T)	15.95	12.95
Robbers of the Lost Tomb (T)	14.95	11.95
Wall Street (T)	16.95	13.95
Electronic Checkbook (T)	16.95	13.95
Data Master (T)	14.95	11.95

BOOKS

TITLE	RETAIL	COST
Adventure Hint Book	7.95	6.25
Apple Book of Software 1983	19.95	14.95
Apple Graphics & Arcade Design Book	19.95	14.95
Kids & the Apple	19.95	14.95
Elementary Apple	14.95	11.95
Games Apples Play	14.95	11.95
Kids & the Atari	19.95	14.95
Atari Book of Software 1983	19.95	14.95
Kids & the VIC-20	19.95	14.95
Elementary Commodore 64	14.95	11.95
Apple Connection	12.95	10.95
Doing Business with VisiCalc	11.95	9.95
Intro to Wordstar	11.95	9.95
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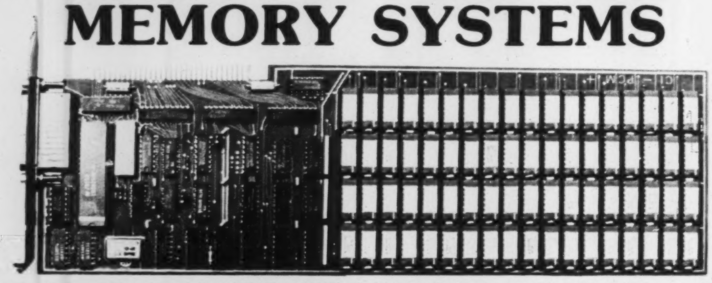

512KB SINGLE BOARD IBM MEMORY W/RS232-C PORT

- Addressable as a contiguous block in 64KB increments thru 1 megabyte.
- On board parity with interrupt on parity error.

SINGLE QTY. PRICE: $795.00

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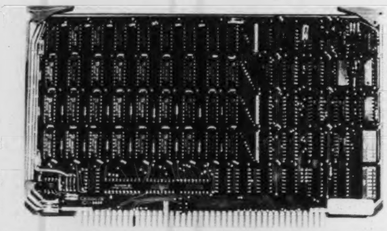
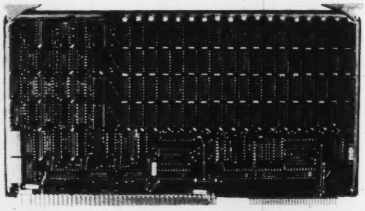


64KB SINGLE BOARD EXORCISER I, II, AND ROCKWELL SYSTEMS 65 MEMORY

- Parity checker on board.
- Addressable as a contiguous block in 4K increments with respect to VXA or VUA.
- Pin to Pin compatibility.

SINGLE QTY. PRICE: $250.00

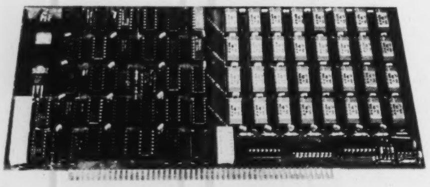
NEW



512MB TO 2MB SINGLE BOARD MULTIBUS MEMORY

- Pin to Pin MULTIBUS compatibility for both 8 bit and 16 bit systems.
- On board parity with selectable interrupt on parity ERROR.
- Addressable up to 16 megabytes.

SINGLE QTY. PRICE:		
	512KB	**$ 895.00**
	1MB	**$4495.00**
	2MB	**$8700.00**

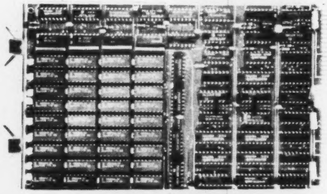


64KB SINGLE BOARD S100 MEMORY

- Addressable as a contiguous block in 4K word increments.
- Battery back-up capability.
- Functions with on-board refresh.

SINGLE QTY. PRICE: $250.00

NEW



256KB TO 1 MB SINGLE BOARD LSI 11 MEMORY

- On board parity generator checker.
- Addressable as contiguous block in 256KB increments through 4 megabytes.
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SINGLE QTY. PRICE:		
	256KB	**$ 595.00**
	512KB	**$2650.00**
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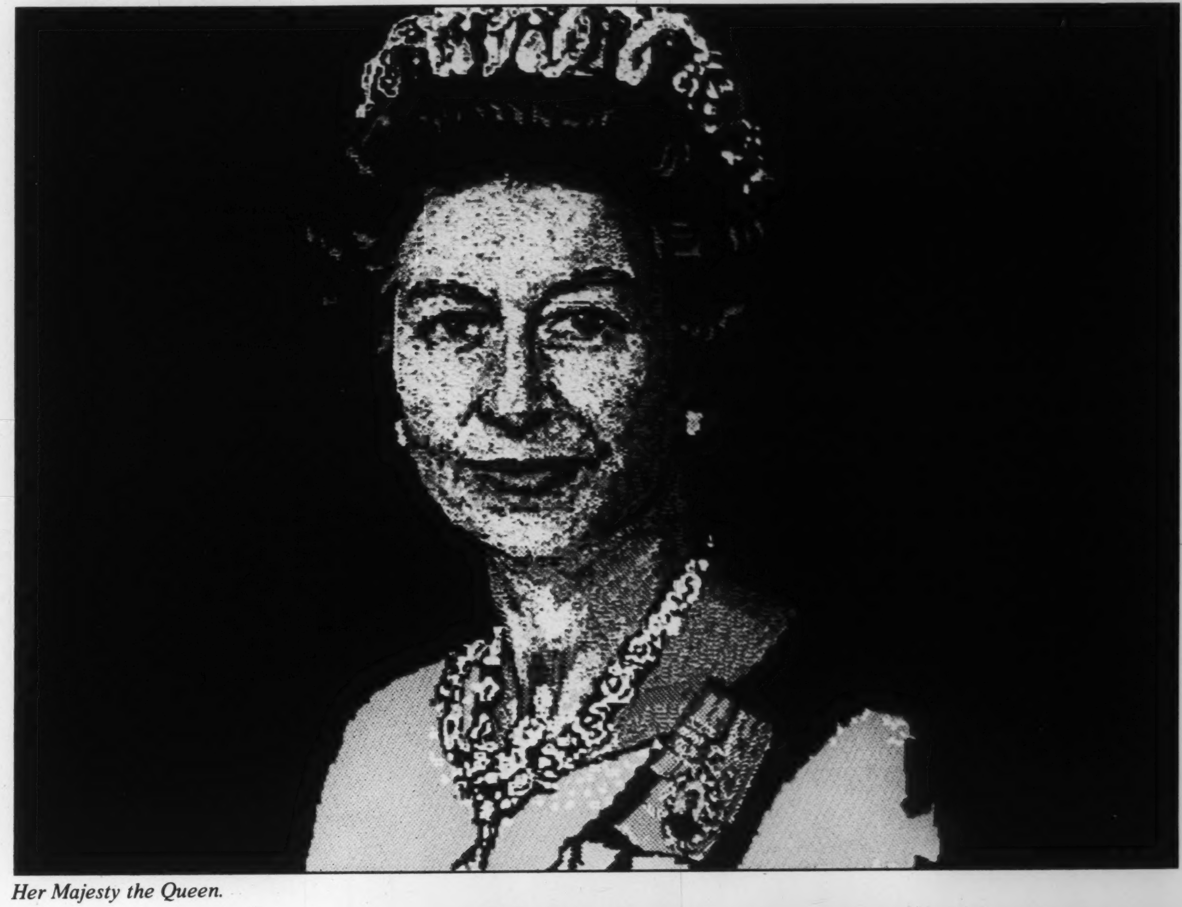
CIRCLE 136 ON READER SERVICE CARD



Her Majesty the Queen.

using a stylus on a graphics tablet. Some of his results grace our cover this month, through his unbridled generosity.

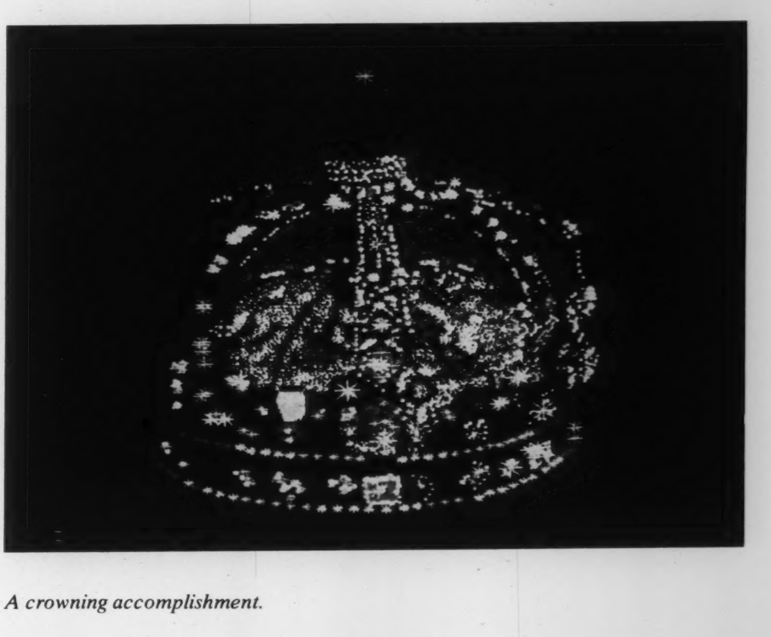
I managed to catch Bernstein between a speech in Chicago and a flight to Comdex in Atlanta, and got him to talk about what he does, and why and how he does it. I found him an extremely engaging subject.

Creative Computing: How did you get started with microcomputer art, and what equipment did you have?

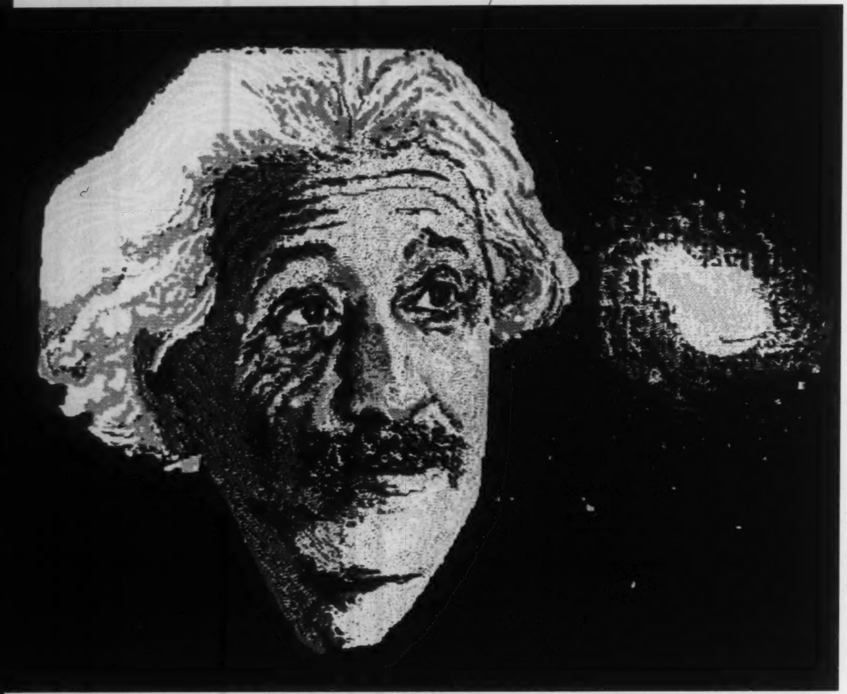
Bernstein: I got started with an Apple II back around Christmas of '78. The desire was simply to be able to paint into a television set.

Creative: You had been painting in conventional media.

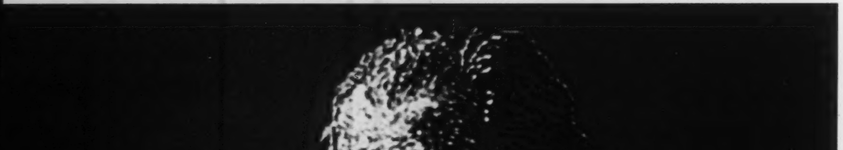
Bernstein: Right. In the early '60s I had what you might call a normal fine arts career, but got tired of the—what would you call it—the elitism of the so-called fine arts. I wanted to communicate more strongly with a larger piece of society. So, after a long discussion with my wife, I decided the illustration field was the place



A crowning accomplishment.



Galactic Einstein: he would have loved micros.



Andres Segovia: illumination from within.

to go. So I began doing straight illustration: oil painting, watercolors, and the like for the NFL, Westway magazine, and stuff like that. And I liked it; the money was good, but what was even better were the phone calls I received from people I knew and people I didn't know—people who saw the stuff after it was printed. I thought, "gee this is wonderful, because it gives me real feedback."

Creative: You developed a forum.

Bernstein: Yes, and beyond that of the fine arts college professor.

Creative: Were had you been teaching?

Bernstein: I teach at California State University of Northridge.

Creative: Then what?

Bernstein: Then I managed to get involved in video—I guess because I wanted to be a better teacher. This was around the time of the campus riots in the late '60s. I remember one woman carrying a placard that said "Make our educations relevant." I thought that made some sense. I had some introspective moments—I realized that the content of what I was saying was good, but I was nevertheless teaching it the same way it had been taught in the 17th century. So I thought about new ways to teach art, and of course television presented itself. I proceeded to build a black and white TV studio in my art studio, and went out and interviewed people in the field. All of a sudden my enrollment grew. The administration of the college was happy with it and supported me.

> ***I remember one woman carrying a placard that said "Make our educations relevant."***

I became fairly comfortable with electronics over this time. I was the engineer, I was the writer, I was the director, I was the interviewer: this gave me valuable experience. I found that industry was largely supportive as well. They were trying to make the bridge to education at that time, which was pretty hard to do, as no ties existed back then. So we got our cameras in there.

You know our society is more or less a vertical one. Everyone is concerned with their own homes and their own jobs, and there's very little lateral communication. That's what I was trying to do, but it was hard to find a vehicle. The video thing, I think, led me to that fateful night I dreamt I could paint into a television set.

Creative: You literally dreamt that you were painting with light on a TV.

Bernstein: Yes. And of course I didn't

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CIRCLE 216 ON READER SERVICE CARD

AARDVARK — THE ADVENTURE PLACE

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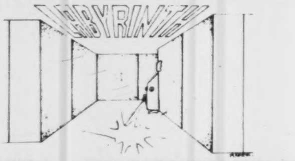
The easiest to use word processor that I know of. Has all the features of a major word processor (right and left margin justification, page numbering, global and line editing, single, double, triple spacing, text centering, etc.) at a very cheap price because we wrote it in BASIC. Includes 40 page manual and learning guide. Easily modified to handle almost any printer combination. Available on disk or tape for VIC20, COMMODORE64, and TRS-80 COLOR computer. Requires 13k RAM on Vic, 16k EXTENDED on TRS-80 COLOR. $19.95 on tape $24.95 on disk. NEW

GENERAL LEDGER — Complete bookkeeping for a small business. Disk required. For Vic20 (13k), Commodore64, TRS-80 COLOR (16k EXTENDED). $69.95 (Send $1.00 for manual before ordering.)



LABYRINTH — 16K EXTENDED COLOR BASIC — With amazing 3D graphics, you fight your way through a maze facing real time monsters. The graphics are real enough to cause claustrophobia.
Similar game for Timex/Sinclair 16k - hunting treasure instead of monsters $14.95.

ADVENTURES

ADVENTURE WRITING/DEATHSHIP by Rodger Olsen — This is a data sheet showing how we do it. It is about 14 pages of detailed instructions how to write your own adventures. It contains the entire text of Deathship. Data sheet - $3.95. NOTE: Owners of TI99, TRS-80, TRS-80 Color, and Vic 20 computers can also get Deathship on tape for an additional $5.00.

Dealers—We have the best deal going for you. Good discounts, exchange programs, and factory support. Send for Dealer Information.

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ADVENTURES — Adventures are a unique form of computer game. They let you spend 30 to 70 hours exploring and conquering a world you have never seen before. There is little or no luck in Adventuring. The rewards are for creative thinking, courage, and wise gambling — not fast reflexes.

In Adventuring, the computer speaks and listens to plain English. No prior knowledge of computers, special controls, or games is required so everyone enjoys them—even people who do not like computers.

Except for Quest, itself unique among Adventure games, Adventures are non-graphic. Adventures are more like a novel than a comic book or arcade game. It is like reading a particular exciting book where you are the main character.

All of the Adventures in this ad are in Basic. They are full featured, fully plotted adventures that will take a minimum of thirty hours (in several sittings) to play.

Adventuring requires 16k on Sinclair, TRS-80, and TRS-80 Color. They require 8k on OSI and 13k on VIC-20. Sinclair requires extended BASIC. Now available for TI99.

TREK ADVENTURE by Bob Retelle — This one takes place aboard a familiar starship and is a must for trekkies. The problem is a familiar one — The ship is in a "decaying orbit" (the Captain never could learn to park!) and the engines are out (You would think that in all those years, they would have learned to build some that didn't die once a week). Your options are to start the engine, save the ship, get off the ship, or die. Good Luck.

Authors note to players — I wrote this one with a concordance in hand. It is very accurate — and a lot of fun. It was nice to wander around the ship instead of watching it on T.V.

DERELICT by Rodger Olsen and Bob Anderson — For Wealth and Glory, you have to ransack a thousand year old space ship. You'll have to learn to speak their language and operate the machinery they left behind. The hardest problem of all is to live through it.

Authors note to players — This adventure is the new winner in the "Toughest Adventure at Aardvark Sweepstakes". Our most difficult problem in writing the adventure was to keep it logical and realistic. There are no irrational traps and sudden senseless deaths in Derelict. This ship was designed to be perfectly safe for its' builders. It just happens to be deadly to alien invaders like you.

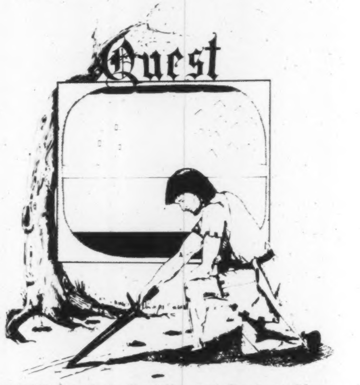
Dungeons of Death — Just for the 16k TRS-80 COLOR, this is the first D&D type game good enough to qualify at Aardvark. This is serious D&D that allows 1 to 6 players to go on a Dragon Hunting, Monster Killing, Dungeon Exploring Quest. Played on an on-screen map, you get a choice of race and character (Human, Dwarf, Soldier, Wizard, etc.), a chance to grow from game to game, and a 15 page manual. At the normal price for an Adventure ($14.95 tape, $19.95 disk), this is a giveaway.

PYRAMID by Rodger Olsen — This is one of our toughest Adventures. Average time through the Pyramid is 50 to 70 hours. The old boys who built this Pyramid did not mean for it to be ransacked by people like you.

Authors note to players — This is a very entertaining and very tough adventure. I left clues everywhere but came up with some ingenous problems. This one has captivated people so much that I get calls daily from as far away as New Zealand and France from bleary eyed people who are stuck in the Pyramid and desperate for more clues.

MARS by Rodger Olsen — Your ship crashed on the Red Planet and you have to get home. You will have to explore a Martian city, repair your ship and deal with possibly hostile aliens to get home again.

Authors note to players — This is highly recommended as a first adventure. It is in no way simple—playing time normally runs from 30 to 50 hours — but it is constructed in a more "open" manner to let you try out adventuring and get used to the game before you hit the really tough problems.



QUEST by Bob Retelle and Rodger Olsen — THIS IS DIFFERENT FROM ALL THE OTHER GAMES OF ADVENTURE!!!! It is played on a computer generated map of Alesia. You lead a small band of adventurers on a mission to conquer the Citadel of Moorlock. You have to build an army and then arm and feed them by combat, bargaining, exploration of ruins and temples, and outright banditry. The game takes 2 to 5 hours to play and is different each time. The TRS-80 Color version has nice visual effects and sound. Not available on OSI. This is the most popular game we have ever published.

32K TRS 80 COLOR Version $24.95.

Adds a second level with dungeons and more Questing.

PRICE AND AVAILABILITY:

All adventures are $14.95 on tape. Disk versions are available on VIC/COMMODORE and TRS-80 Color for $2.00 additional. $2.00 shipping charge on each order.

Please specify system on all orders

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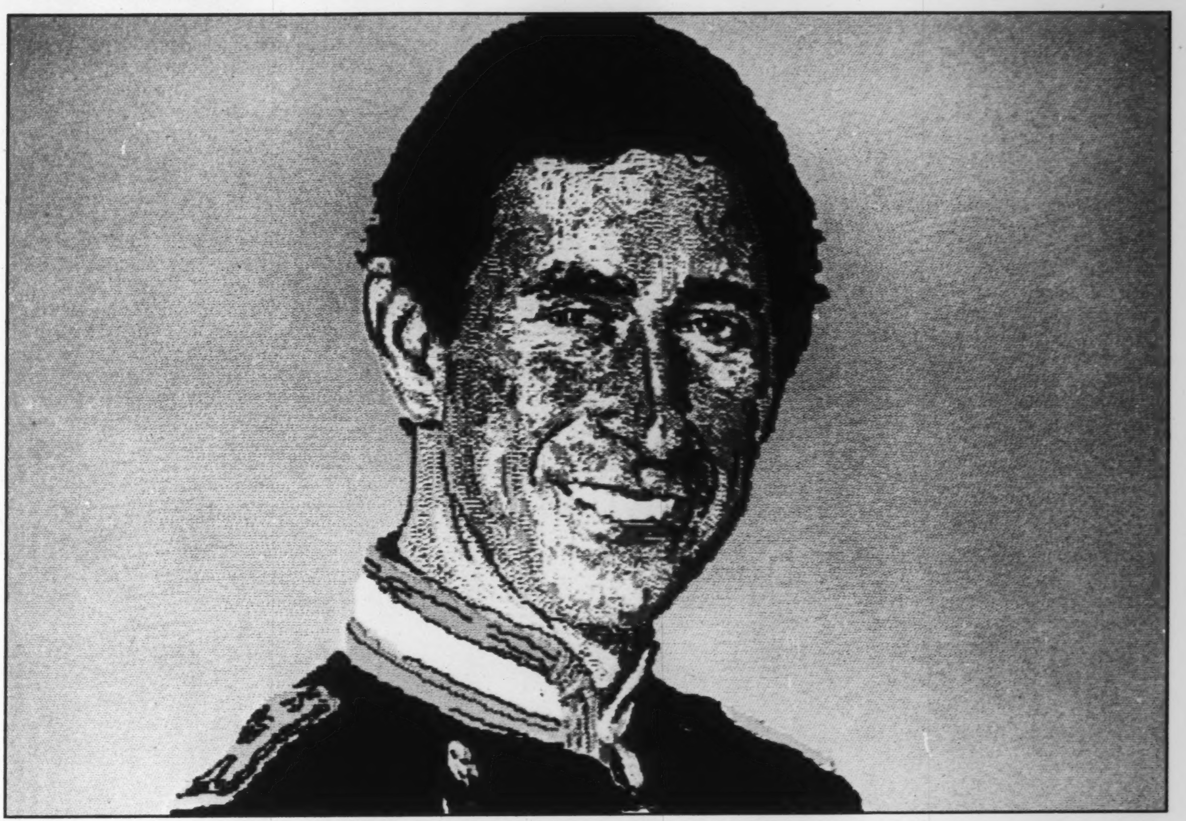


Bonnie Prince Charlie.

know how to do it, but from that moment on I wanted to. I talked to people with greater knowledge about those things, and they told me I needed a computer. They also told me I'd have to learn to program. I said "no, I don't think I want to do *that*." I was too old to go back to college as a freshman in computer science. But it did get me thinking about computers.

I went into a couple of stores to see the TRS-80 (Model I) machine in '76 and '77, but nobody could ever get the damned thing to work. I remained suspicious.

Then I saw the Apple. All the fellow could do at that particular store was run the color bar demo and a primitive version of *Breakout*. But when I saw the color bars on the screen, I said "if he can do that, I can paint." And that was how it all started.

To show you how good I am, it took me three months after getting the thing home to get it to save a sentence, and the manual was gibberish to me.

Creative: It was 20 mimeographed pages back then.

Bernstein: It was for programmers. I couldn't understand a word of it. It was tough enough trying to save to cassette, which was the only means of storage back then. I'd hear that "beep beep beep" and I wouldn't know what in the world was going on.

But I kept working at it, almost as an obsession. Then I met a fellow named Rod Mansfield, who has turned out to be one of my best friends in the industry. The first night we met, I asked him how I could paint on an Apple computer. He introduced me to the then-prototype of the graphics tablet. He wrote some primitive software for me, something on a par with an Etch-a-Sketch—no fills, no vector capability. But I was painting on the screen. He also introduced me to the disk drive. I was still working on a television set, too. Color monitors came later.

After about a week, I had a bunch of pictures, including the one of Einstein, which became so popular. Rod came over, and just stood there with his mouth open. "You think I could have copies of these," he asked? I said, "if you know how to make copies, be my guest." I was still quite a novice.

I had no idea what he meant to do with the disk. But I soon found out. I got a call from Mike Markkula at Apple, asking me to come up for a visit, so I did. They asked me if I wanted to visit New York in June (for the NCC). I said "well sure," not knowing what for. I didn't quite know it then, but I had become a part of Apple's marketing. As they say, fools go where angels fear to tread. But I had a great time in New York, despite the fact I knew nothing about conventions or graphics tablets or software. I did have suggestions, and have always enjoyed talking to people, and I had a wonderful time.

Creative: That probably made you the perfect person for Apple to wheel around back then—the fact that you were an artist as opposed to a programmer, nor were you much interested in the hacker aspects.

Bernstein: I've worked on many machines, some of them very sophisticated. Yet I have never cared much about what's in the box. I would rather discover the limitations for myself, in my own way.

Creative: The less you know the better?

Bernstein: Something like that. Show me how to boot it up, then leave me alone to play. You might call it "disciplined play." I really believe in the power of play. Can you imagine the fun the person had, who invented the bathtub? I would like to have seen that first automobile get rolling. What did Orville Wright really *feel* when the wheels left the ground?

Creative: Or the astronauts appreciating the view from the Columbia.

Bernstein: No one has bothered to ask Shepard or Glenn how it really felt to be up there for the first time. And here I was with wonderful brand new boxes and the time to explore. Give me the box, and I'll draw some pictures. That's my mode of operation. And people have turned around and liked the pictures.

Creative: Somehow the Einstein thing really seemed to touch people. It was so fitting, you know.

Bernstein: Well I thank you. I'm just so pleased. You know I really don't look at graphics computers as something frivolous—as merely games machines. They are a modern indicator that conventional forms of education have become outmoded and antique.

Creative: Can you elaborate on that point?

Bernstein: Yes. America started out as an agrarian society, then became an industrial one, and now is being transformed into a technological one. And yet our schools are still being run as if we lived in an agrarian society! That's why they let the kids out at 3:00—to tend the farm.

Creative: Why are we still following such antiquated schedules?

Bernstein: Well school boards will tell you first off that it's budgetary. They just can't afford to keep the business of education up any longer. I don't know about that. I think the (micro)computer industry would be more than happy to donate machines to schools, which could really help the situation.

Creative: In fact some companies, like Apple, have already offered to do so.

Bernstein: And they are having a hard time. Education is frightened to death that industry will make money from that kind of proposition. Well, I want them to make money. I want Apple to make millions of dollars. I want IBM to make millions of dollars. I want all of them to make billions of dollars, if they get our kids interested in learning.

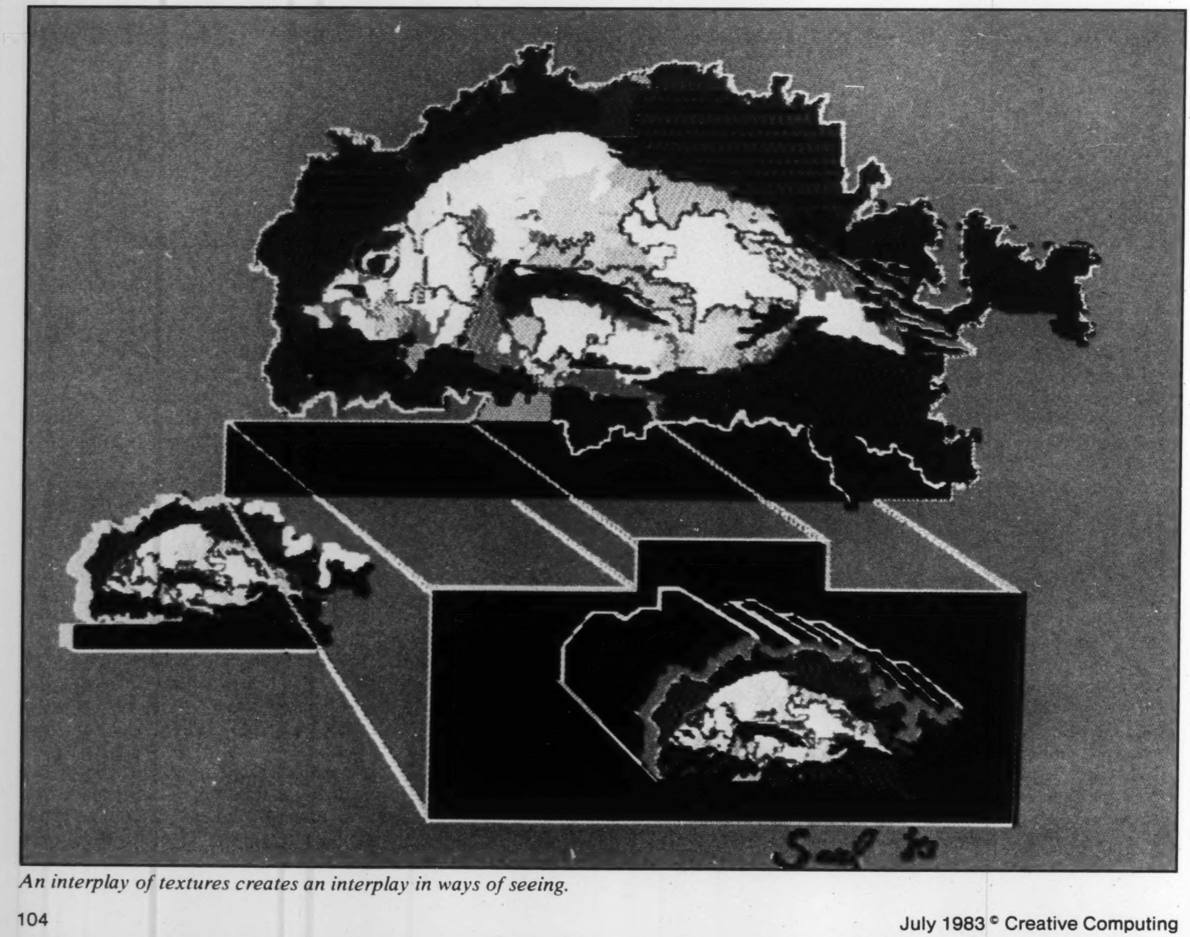
Right now this country is turning out 11,000 engineering students a year. In the Soviet Union, the number is closer to 50,000 a year. Now it doesn't take much to realize that even though we'll soon have a battleship in every backyard to protect us, we're going to be a third-rate power in short order. The only answer to that kind of problem is an investment in youth.

The President says that our Social Security problems are solved until the year 2000. That's wonderful. That's great. But what about underwriting education? I'm old enough to remember the GI bill for education. It made the difference for kids who went into the service as meat-packers in '41 and became doctors after they got out. The difference in their taxes was enough to make it a winning investment.

Creative: And you see computers as a means to this end in education today.

Bernstein: As a splendid means.

Creative: Let me go back to a point you touched on earlier: you talked about a vertical trend in today's society. Many people see computers as contributive to



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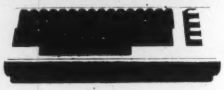

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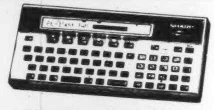

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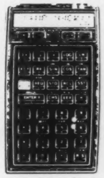

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that very problem. Parents worry about the kids sitting in their little cocoons, playing Pac-Man instead of learning to relate with others, or even programming as opposed to interacting with other students in a classroom.

Bernstein: What I'm talking about is computers as a supplement to transactive education—not a substitute for it. I'm not saying that you can educate a kid solely with a computer. But from 3:00 until 5:00 in the afternoon, give him a room with a computer and let him learn about solitary meditation. He'll still have plenty of time to interact.

In the future America will resemble its old agrarian self once again. Both parents will stay home with the kids. It will have a positive impact on the concept of the family—we could create a kind of tight-knit family that would be the envy of the world.

Creative: What about the concept of "community"?

Bernstein: The first thing many Americans do when they have a bit of money is head out to the suburbs, buy a plot of land, and put a fence around it. They don't want to talk to their neighbors. Well today I think we can use technology to help us interact. We're all going to have dishes on our roofs, and interactive cable TV, and intelligent phone systems.

Creative: In an electronic community there is a sort of democracy—only my thoughts are transmitted—not my religion or my race or my speech patterns or anything else that may affect your opinion of me unduly.

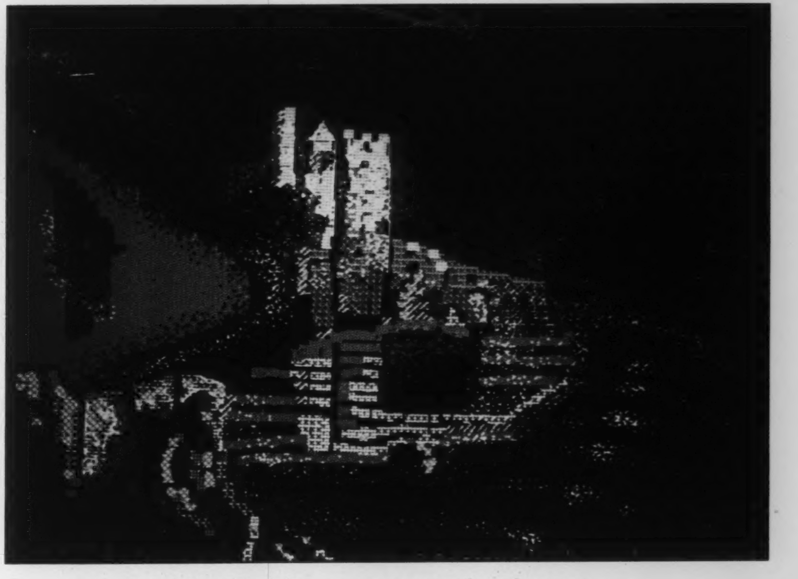
There have been only two art forms in the whole history of man in which color is on the attack: stained glass windows and television—everything else is ambient light.

Bernstein: I think what you are really bringing up is a kind of new equality. What better way to break down all the "isms" that we have so we can treat each other as human beings. It could change the world. If form really does follow function, then if a function in our society is to become more equal, then our form will follow. That would be great, huh?

Have you ever been to a user's group meeting?

Creative: Talk about community.

Bernstein: There's proof enough: these people may live in the suburbs, they may be from the inner city, minority group members, kids, whatever. And all the barriers are gone once they start talking about Applesoft or some new program. I believe in that kind of power. That may very well be the reason why Pac-Man lives, so to speak.



Bernstein dares to fail, and in doing so, opens new realms of success.

As I've said over and over again, there have been only two art forms in the whole history of man in which color is on the attack: stained glass windows and television—everything else is ambient light. The subliminal attraction of video games is akin to that of the windows in a cathedral.

Creative: Let's talk just a little bit about the hardware. What are the tools you have been working with lately?

Bernstein: Well I started with the Apple II, and now I have an Apple III. Then I have an Intelligence Graphics System with one of the most marvellous color terminals around. Then the HP-2700 from Hewlett-Packard—boy that's a nice machine. It has a resolution of 512 x 512 in 16 colors, but what they do is allow you primary, secondary, and terciary colors, and you can actually mix them on an electronic pallette.

Creative: All these machines use a tablet for input.

Bernstein: Yes, though I find myself using the keyboard more and more often with the IGS for total control of each dot.

Creative: The HP-2700 was the machine you used to draw the Queen?

Bernstein: Yes. And I really must give Hewlett-Packard an immense amount of credit for a wonderful system. They created a superb piece of hardware and a superb piece of software to drive it.

I have an animation videodeck, which allows me to create moving images on videotape. I also have several different kinds of cameras: among them is one called a "kinecamera," which hooks up to the Apple III directly. I have a batch of printers, too—black and white and color.

Creative: Haven't Abel Associates or III or MAGI or NYIT tried to snap you up?

Bernstein: Nope. I have a friend who is a banker, and oversees a prestigious committee of financial advisors. Each, over a period of years, has had about 85% success in predicting economic trends. But when you put them together, their combined success rate is something in the low '30s. You just can't do much in a committee.

If I have an idea, I'll be up at 3:00 in the morning doing it. I want to contribute to society, but I want that contribution to be wholly mine. And that may mean holding on to something for a long time, until I am pleased with it. I couldn't do that if I was working for a large company. The other thing with large organizations is that they don't afford you the opportunity to *fail*. And I put much stock in the word "failure."

Creative: Certainly it is something an artist must be free to do.

Bernstein: Success is not a great learning experience, but failure is. You have to take the chance: to dare, to go beyond, to push the outer limits—until you get that error message. Then you can go back and do something productive. ☐

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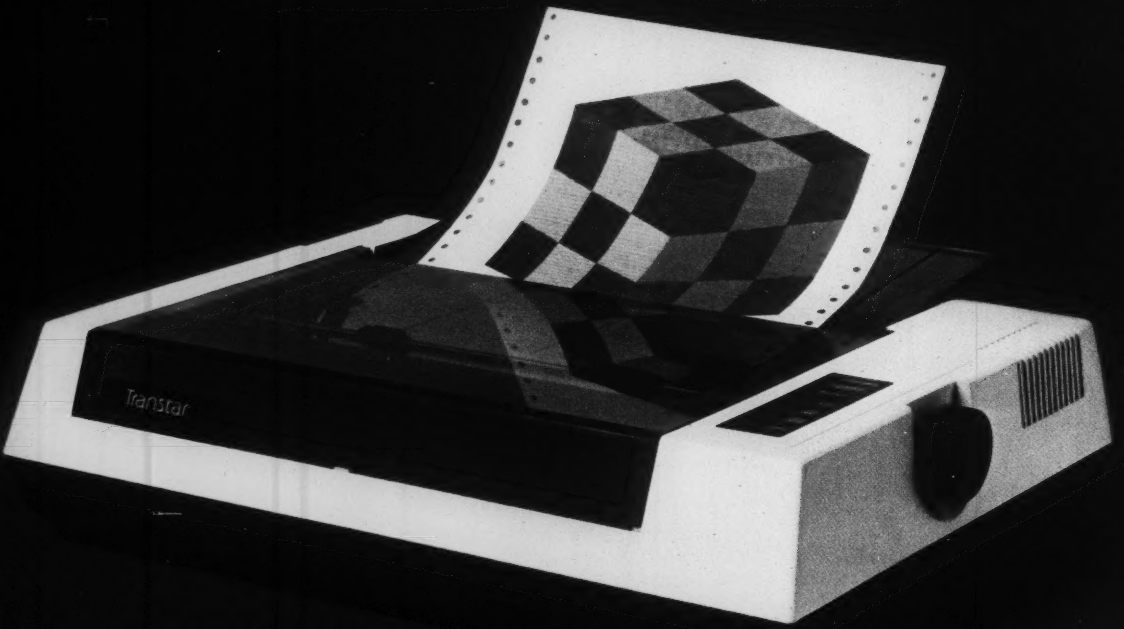

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Computers Make Music

Patricia Smith

In a living room in Oakland, CA, Tim Perkis, John Bischoff and Jim Horton of the League of Automatic Music Composers connect their microcomputers. Each composer has programmed his computer with different musical elements. The computers, which constitute a band, perform. Interacting with each other, they create music.

The sounds from each computer affect the sounds produced by the other two computers. One computer selects melodic patterns. Another calculates which harmonies to play, and the harmony influences rhythmic patterns, Horton explained.

Because the sounds of one computer affect the sounds of another, the musical results are unpredictable. As the Sunday afternoon work session begins, the music is loud, turbulent, and dissonant. But the music changes, sometimes gradually, sometimes suddenly. For a while, the music is eery. At times, it is rhythmic and lively, sounding like jazz. Sometimes it is lighter and gay, sounding almost as if it came from a calliope.

"We're composers, not performers. The sound of what is pleasing is worked out when we are composing. The computers are doing the performing. In a concert, we're listening," Horton said.

At a recent concert at the Mills College Center for Contemporary Music (CCM) in Oakland, David Rosenboom sits down behind the Touché, a computerized instrument he and Don Buchla designed. At times, he stands up or raises and swings his arms as he moves the levers that control the output of continuous, rich melodic sounds. Once, he jumps up and moves over to the piano. Accompanying the Touché, he plays jazzlike rhythms wildly. He returns to the Touché; but before the piece, "Nova Wind," is over, he gets up again and plays the violin.

"Nova Wind," composed in 1981, is one piece from his recently released album "Future Travel" (from Street Records). This album contains "the most elaborate use of live performance, computerized instruments that I have done to date in terms of the complexity of the sound generating process," he said.

At a college lecture, computer designer and composer Andy Moorer talks about synthesizing sounds for musical purposes. Moorer works with a large computer at Stanford's Center for Computer Research in Music and Acoustics (CCRMA).

His demonstration tape illustrates his techniques. In "Perfect Days," there are three distinct sounds: Charles Shere's voice as he reads the Richard Brautigan poem, the sound of a flute played by Tim Weisberg, and a modified sound that is part speech and part flute, that has the vocal qualities of speech, but the pitch of the flute.

Current Trends

There is no typical style or sound in

Photo by Edward W. Souza.

In the computer room at CCRMA: from left, music grad students David Jaffe and John Gordon, director John Chowning, and Music Department alum Bill Schottstaedt.

Patricia Smith, 355 Fair Oaks St., San Francisco, CA 94110.

computer music. Composers who use computers draw from varying musical traditions and produce very different kinds of compositions. The League of Automatic Music Composers' music, in which microcomputers interact with each other in an improvisatory way, differs from complex ensemble compositions and synthesized musical poems.

Using computers to create sounds is one trend in contemporary music. "It isn't reasonable to think electronic music will replace traditional music. It's simply another medium," CCM program assistant Larry Polansky said.

It isn't reasonable to think electronic music will replace traditional music.

Although most of the music at Stanford has been produced on the University's large, specially designed computer, other Bay Area composers use small computers, which are attached to synthesizers, keyboards, or other sound-producing devices. These composers, who often construct their own computer instruments, write musical instructions which tell the computer to act in certain ways.

Composer and music system designer Paul De Marinas recently built a computer music exhibit for San Francisco's Exploratorium. In collaboration with New York composer and designer, David Behrman, De Marinas designed six touch-sensitive guitar models. He attached the guitar models to a single-board computer, an Apple computer, and three Casio keyboards. Exploratorium visitors who touch the guitars activate the single-board computer, which activates the Apple. Depending on which keys on which guitars are touched, the Apple figures out what harmonies and rhythms to play on the keyboards.

De Marinas is interested in harmonies and said his pieces are tonal. He designed the Exploratorium piece so that "whatever is played by six kids who intuitively know harmony is immediately successful."

In all of his pieces, De Marinas said, he "aims to make systems that I could play or others could play beautifully, where walks could be taken spontaneously."

De Marinas, who obtained an MFA from Mills College and has taught at San Francisco State, believes the aesthetics of instrumental and electronic music are the same. "Basic musical things are beautiful. An identifiable phrase repeated over itself is capable of becoming beautiful," he said.

Other computer music composers agree that the aesthetic qualities of what makes good music are the same for all musical genres. "We're sometimes dealing with very different compositional procedures or live performance set-ups, but I don't find the aesthetics different," Rosenboom said.

Antecedents

"Electronic music has been around for 30 or 40 years, and there have been composers of tremendous importance," Polansky explained.

One is John Cage. Horton, who was doing graduate work in philosophy in the mid-sixties, was influenced by Cage. Cage's music "was startling, exciting, and beautiful," Horton said.

Photo by Ariel Thomas.

Center for Contemporary Music.

"Cage was in the first generation," Mills graduate student Phil Stone explained, adding he was inspired by Alvin Lucier, who was in the second generation. "I started out at Wesleyan wanting to be a lawyer, but got interested and caught up in music through Lucier."

"Lucier was called a physicist. He explored things about the nature of sound. The pieces he composed are beautiful. They're elegantly simple from complex processes. That was inspiring."

Rosenboom became interested in electronic music at the University of Illinois in the mid-sixties and worked with Lejaren Hiller, whom he describes as a pioneer in computer composition.

"Most people were making tape pieces at that time, but I was particularly interested in live performances because of the potential to somehow manifest processes which we normally think of as compositional, precompositional, or perceptual in real time, that is, in bringing some of the composing activity into live performance," Rosenboom said.

Brain Wave Music

During the 1970's, Rosenboom went to York University in Toronto where he was one of the founders of the New Music Department, built the Laboratory of Experimental Aesthetics, and composed and recorded his "brain wave" music.

In these pieces, Rosenboom used a computer to analyze neurological signals in musical perception and then generated music from the results. In his piece "On Being Invisible, " electrodes are attached to the head of a person who is the solo performer. The signals are recorded on standard electroencephalographic equipment. A computer analyzes the signals according to a model of how people divide groups of musical phrases into temporal segments, and this analysis determines what sounds are produced on a synthesizer.

"Everything the computer outputs is tested against the model to see if it can determine what are potentially, significant landmarks," Rosenboom said. If the computer determines some structural events are significant to the listener/performer, "it will make it more likely that the kinds of changes that are causing the response will occur again. If the prediction is false as determined by the lack of evoked response, it will tend to cause the sound patterns to change in some way."

Electrodes are attached to the head of a person who is the solo performer.

Although Rosenboom has plans for more brain wave pieces, he hasn't composed any since coming to Mills College in 1979. "I decided I needed a little break. Also, I wanted to work on some other kinds of music and I got involved with Don Buchla in the development of a digital keyboard instrument," he said.

During his recent concert at Mills College, Rosenboom performed some of his other music—selections from "Future Travel" and a piece in which he used a harmonic and rhythmic computer language to create a composition for four cellos, percussion, and a trombone.

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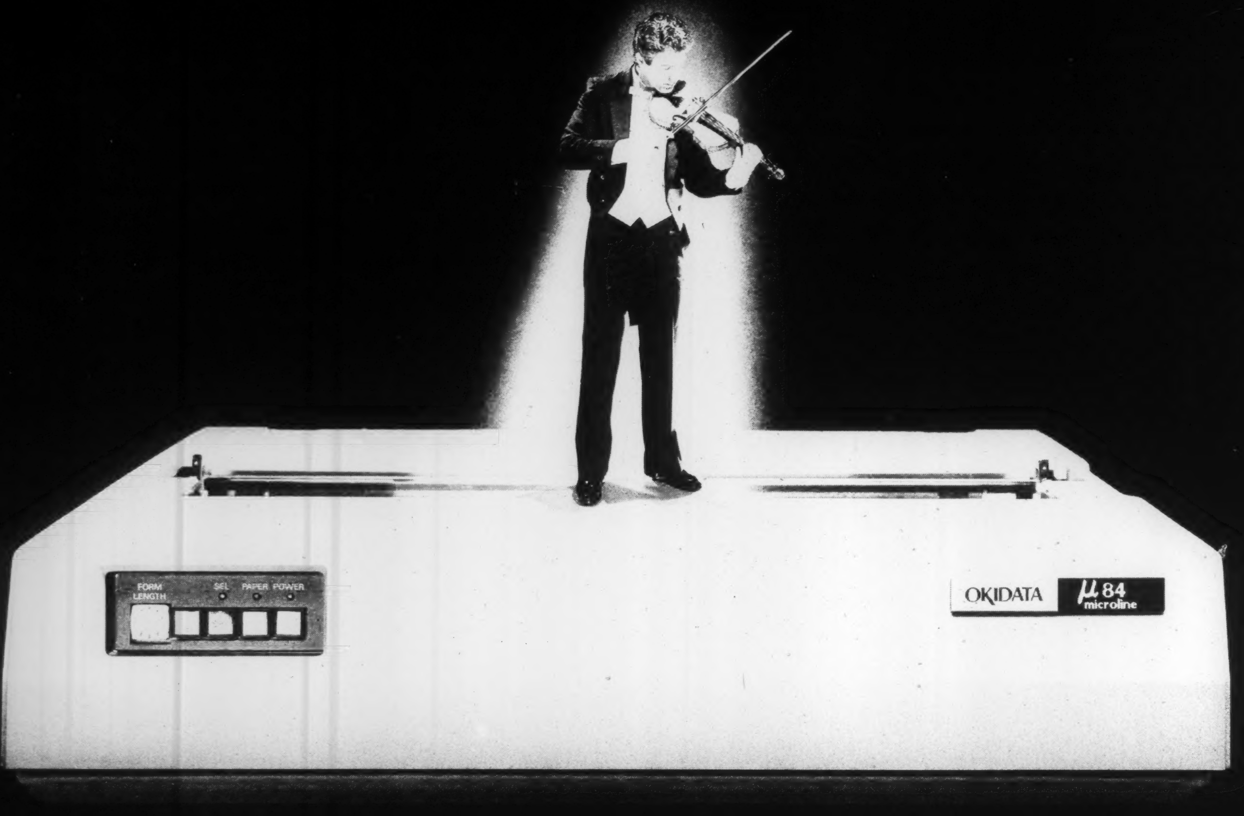

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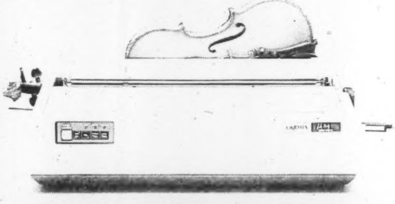

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CIRCLE 212 ON READER SERVICE CARD

Computers Make Music, continued...

Polansky said of his colleague.

Composer John Chowning first started working with computer music at Stanford in the 1960's. He read an article about Max Matthews and J.R. Pierce, who were doing acoustical research at Bell Laboratories, and then went to Bell Laboratories to see Matthews.

"John came back and started implementing new ideas," CCRMA administrative assistant Patty Wood explained. Chowning began initially working with a large computer in the off-campus facilities of the artificial intelligence division of the computer science department. When the artificial intelligence group moved back to campus, CCRMA acquired more space, as well as their own new, large computer and synthesizer.

Composers who use Stanford's computer music system define parameters of sound (i.e., pitch, tone) with numbers and commands which the computer can read and interpret. At a recent CCRMA demonstration, composer-in-residence Janis Mattox explained that the computer interprets the commands and sends them to the synthesizer, which produces sound.

Using Real Sounds

Many people at Stanford, as well as places like Bell Laboratories and the Institut de Recherche et Coordination Acoustique/Musique in Paris, have been doing research into the dynamics of real sound and what makes sound interesting. "It turns out that real sounds are extremely complex, and this is what makes them easy to listen to as opposed to what most people think of as electronic sound," Mattox explained.

With a large computer, composers can analyze real sounds. "We figure if we can get close enough to duplicating real sounds that we can control—not that we want to duplicate the actual sounds—our sounds can be as rich and interesting," Mattox said.

"We can do just about everything an original violin can do; but to have a computer play something exactly like a violin would play it would be pointless and probably impossible," Stanford DMA candidate David Jaffe explained.

For the second movement of "Shaman," Mattox wanted a sound that was intense and primal to go along with a belly dancer's gestures. "I wanted a real ambiguity between an instrument and a voice. I wanted something that sounded like either and shifted back and forth, and I think I got pretty close to that. I'm accompanying it now with some very low drum sounds. It's going to be quite rhythmic," she said.

In another piece based on a Richard Brautigan poem, Moorer took the voice reading the poem and changed some of the dynamics of the speech, for example, by adding some reverberation to portions of it.

In his piece "Silicon Valley Breakdown," Jaffe has synthesized new sounds from guitar sounds. He also played with tempos, speeding them up and slowing them down, and brought voices together and apart at different times.

> ***Mattox wanted a sound that was intense and primal to go along with a belly dancer's gestures.***

"With a computer, we can do interesting things like slowing sound down without changing the pitch or changing the pitch without changing the speed," Mattox explained.

For many composers, the expense of a large computer like Stanford's is prohibitive and microcomputers are the only alternative.

In 1976, Horton responded to an advertisement for a computer for $250 with a coupon. "They sent a wonderful computer," he said.

Horton read the instruction books and started building electronics for the computer, learning on his own and from people he knew.

A significant difference between composing for the computer and composing for traditional instruments is that computer music composers don't have to read music. But, somewhere along the line, like Horton, they usually learn something about electronics and programming.

"When the microcomputer came along, people interested in it got together—for a long time, at regular Sunday open houses at the East Bay Center for the Performing Arts. We (The League of Automatic Music Composers) have been working together since 1978," Horton said.

In the Oakland living room, Perkis, Bischoff, and Horton's computers sit on separate, but adjoining tables. Wires connect the computers to each other, to mixers, and to control boxes.

"My computer is playing equal tempered melodies and Tim's is playing harmonies. Now his computer is tracking to mine," Horton says.

While Horton explains interactions of the computers, Bischoff and Perkis sit intently in front of their computers, moving nobs and levers. Perkis is calm. At times, Bischoff smiles. At one point, Horton's eyes shut and he hums along with his computer.

"Some of the sounds are wonderful," he says. □

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Translingo

Hinrich Murken

What is Translingo?

Translingo is an artificial language that serves to convert abstract symbols into letters, letters that may be assembled into proper words that we can pronounce and speak. It is, therefore, well suited to use by computers.

Translingo consists of several different levels. This article deals with TRA 2 or second-level Translingo, which deals with music. (TRA 1 deals with mathematics, TRA 3 with geometry.)

I consider Translingo to be a sub-set of the English language. It is the word-forming principle; the words produced are not Translingo but English.

We are now speaking of music and thus second-level Translingo:

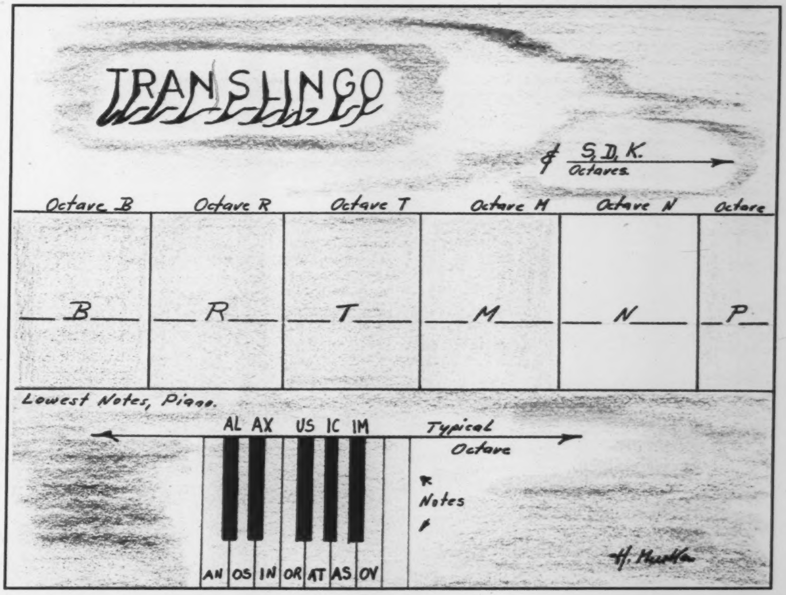
The first letter of any Translingo term can be a capital letter, small letter, or an underlined letter. If the first letter is a capital letter, you are instructed to use your right hand to execute the musical instructions to follow. If the first letter is underlined, you are instructed to use one or both feet to execute instructions to follow.

A capital letter commonly is followed by melody instructions. A small letter is commonly followed by bass instructions, and the underlined letter defines the use of pedals—piano and/or organ.

The first letter is called the octave letter and serves to define to which octave a certain sound belongs. The following are the octave letters. (B is the lowest octave):

1 - B
2 - R
3 - T
4 - M
5 - N
6 - P
7 - S
8 - D
9 - K.

If the octave letter is a capital, use the



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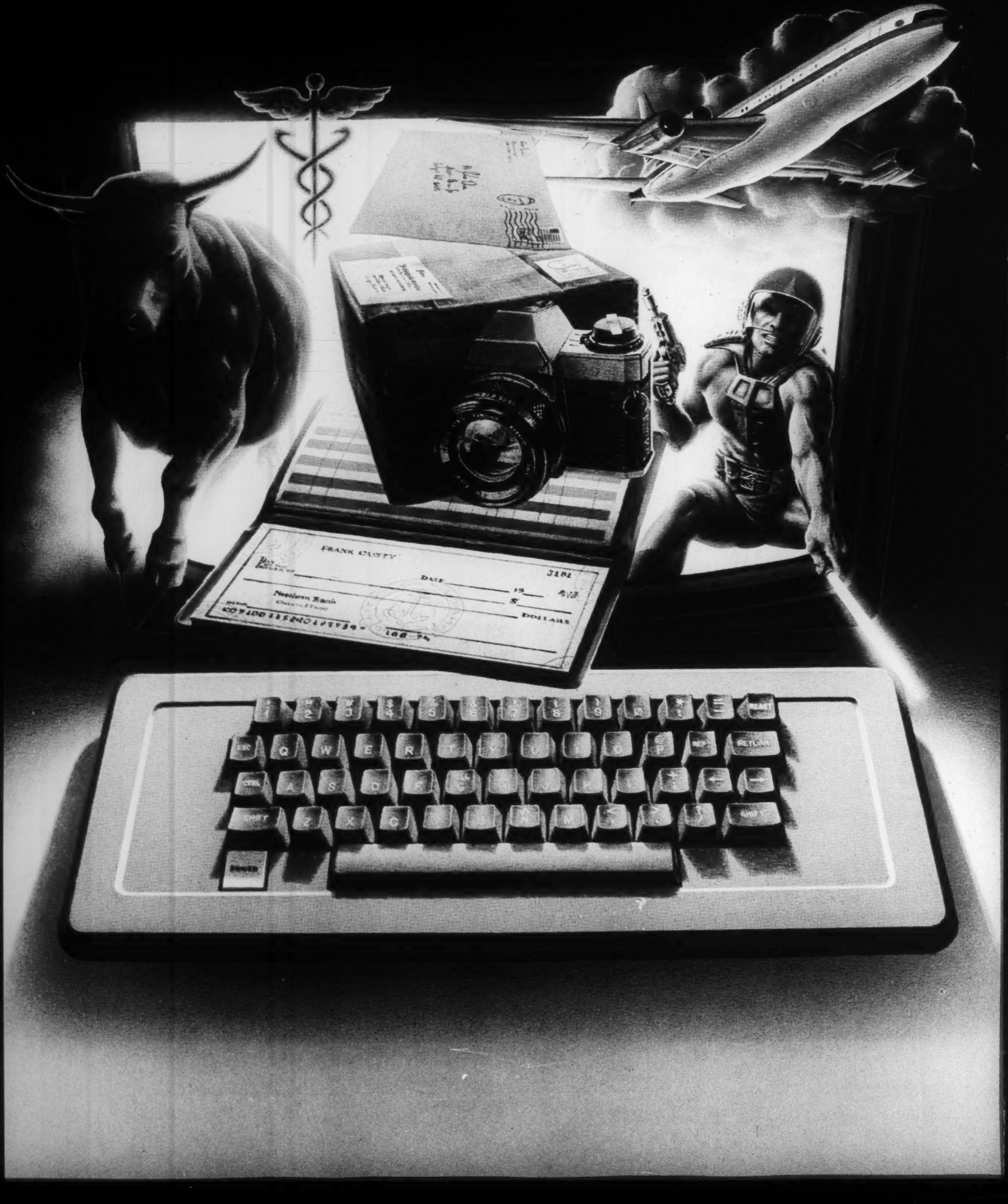
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DOLLARS
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RETURN
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SHIFT
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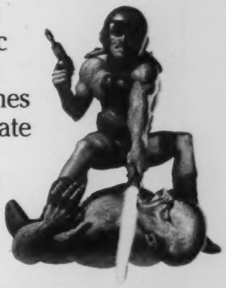

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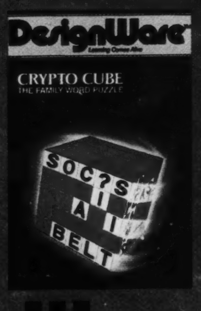

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CIRCLE 152 ON READER SERVICE CARD

right hand to play (melody). If the octave letter is a small letter, use the left hand to play (bass). If the octave letter is underlined, use the foot pedals.

The second letter is called the volume letter and defines how loud or quiet a sound is to be. We have the following letters:

U - very quiet
E - quiet
I - normal volume
A - loud
O - very loud
Y - your choice of volume

The octave letter and the volume letter are always linked in a syllable.

The third letter of a Translingo term defines the duration of sound we want. The following letters define durations of sounds:

B - Whole note
R - 3/4 note
T - 5/8 note
M- 1/2 note
N - 3/8 note
P - 1/4 note
S - 1/8 note
D - 1/16 note
K - 1/32 note
L - 1/64 note

Accordingly we may create words. Ram, for example means: Use right hand; place right hand near second octave of keyboard; prepare for volume A (loud); and the musical sounds are to be of 1/2 note duration.

The first three Translingo term-letters define octaves of sound, volume of sound and duration of sound, and which hand to use. If the first three letters are followed by a dash, all notes to come are to be played at once, constituting a chord. The following are the note-letters:

An -	C	In -	E	Ic -	G#
Al -	C#	Or -	F	As -	A
Os -	D	Us -	F#	Im -	A#
Ax -	D#	At -	G	Ov -	B.

Therefore, Ram-axanos means right hand chord; volume, loud; duration, 1/2 note; second octave; D#;C;D.

Ramaxanos means right hand notes; volume, loud; duration, 1/2 note; second octave; D#; C;D.

Observe that the note-letters are written in the way you are to finger the keyboard—they define the order of fingering.

We write right hand instructions above left hand instructions as shown in Figure 1.

Note: The first three letters defining octave, volume, and duration do not need to be repeated or mentioned unless a change in octave, volume, or duration is desired.

Right Hand X Samaxan, axan, axan, axan, (Melody)
Left Hand X bemaxan, axan, axan, axan, (Bass)

Figure 1.

Attack	*Sustain*	*Speed*	*Vibrato*	*Tremolo*	*Reverb*	
Cha	Da	Can	Tas	San	Nax	Very light
Che	De	Cen	Tes	Sen	Nex	Light
Chi	Di	Cin	Tis	Sin	Nix	Natural
Cho	Do	Con	Tos	Son	Nox	Heavy
Chu	Du	Cun	Tus	Sun	Nux	Very Heavy

Figure 2.

Letters above the term line indicate lead-in notes, and letters beneath the term line indicate lead-out notes:

Samaxanim$\overset{\text{Im}}{\text{ov}}$	Samaxanim$\underset{\text{Im}}{\text{ov}}$
(Lead-in)	(Lead-out)

Dots above letters indicate staccato:

Samåxånôv

Use the comma to indicate measures and the period to end musical statements. Use long straight lines and underline all musical notes and measures which go together.

The letters la mean "repeat the foregoing once." Le means "repeat twice." Li indicates three times; lo, four times; and lu, five times.

Ton means last note. Pin means last chord, das means last measure, and ros means last bar. Bos means "from the beginning." You can combine repeat letters and repeat specifications into single words. Repeat instructions always follow Translingo terms:

Sam-åxånôv laton

Durations of silence are written thus:

By - Whole note rest
Ry - 3/4 note rest
Ty - 5/8 note rest
My - 1/2 note rest
Ny - 3/8 note rest
Py - 1/4 note rest
Sy - 1/8 note rest
Dy - 1/16 note rest
Chy - Pause

The Percussion letters are shown in Figure 2.

Percussion letters are made into single words which precede Translingo terms:

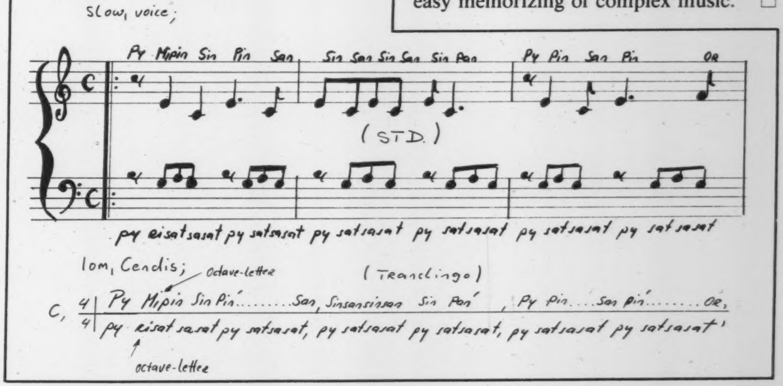
Chaditos sannox: Sam-åxånôv laton

(Percussion): (Function) (Repeat)

The player plays according to what is written, and since each note is fully and individually defined, he does not have to worry about keys, flats, sharps, inversions, etc.—those matters are the composer's problems. The composer must write in the proper key and define the chords and the order of note fingering. The player plays only what is written.

Translingo words are designed to display rhythm of music, and mnemonic principles have been used to allow the easy memorizing of complex music. ☐

"Sentimental Journey"


Slow, voice;
Py Mipin Sin Pin San, Sin San Sin San Sin Pan Py Pin San Pin OR
(STD.)
py eisatsasat py satsasat py satsasat py satsasat py satsasat py satsasat
lom, Cendis;
Octave-lettee
(Tranclingo)
C, 4/4 Py Mipin Sin Pin´........San, Sinsansinsan Sin Pan´ , Py Pin....San Pin´........OR,
py eisatsasat py satsasat, py satsasat py satsasat, py satsasat py satsasat'
octave-lettee

Variable Speech

Herb Friedman

Like the computer, the human brain can assimilate information much faster than information can be fed in. In fact, when listening to speech, the brain works at about one-half to one-third of capacity and it gets bored, often causing the listener to lose track of what is going on. Experiments have shown that the brain works most efficiently if the information rate through the ears—via speech—is the "average" reading rate, which is about 200-300 wpm (words per minute), yet the average rate of speech is in the neighborhood of 100-150 wpm.

In short, the brain works at about one-half of its assimilation capacity when listening to speech; whether it is a classroom lecture, an educational cassette tape, or even a TV show. Experiments have also shown that the brain tends to wander when working well under its capacity, so the listener often ends up tuning out altogether.

Speed Increases Understanding

Comprehension is not only increased if we speed up the rate of speech, but we can assimilate two or three times the amount of information in the same time. Instead of listening to an educational tape for one hour, by doubling the speech rate—which is called "speech compression"—we could hear the same information in only 30 minutes, and the brain would comprehend more because it wasn't watching the clouds drift by.

In fact, this is exactly what is done in some TV commercials and by many large companies such as IBM and Sperry, who use "speech compression" in their training tapes. Their trainees spend 50 percent or less of the normally expected time listening to tapes. For example, they actually spend less than 30 minutes listening to tapes it took an educator 60 minutes to record. In the case of TV commercials, speech compression allows the sponsor to almost double the size of the sales pitch he can throw at you: in effect, he is broadcasting two commercials for the price of one.

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PLAY
CUE
STOP EJECT
VOLUME
VSC

A VSC system can be built within a portable cassette recorder. In this model from the VSC Corp., a linear slider control, similar to the volume control, adjusts the VSC rate from 0.6 to 2.5—which allows the user to either expand or compress the speech.

You might expect that speech compression, which is technically termed VSC, for Variable Speech Control, can be done by simply increasing the playback speed of a tape recording perhaps two or three times. But when you do this, the recorded frequencies and the "rate of speech" are increased proportionately to the increase in tape speed. If the tape speed is doubled, the rate of speech and frequency response is doubled, producing the "Donald Duck" effect in which the voice gets so high-pitched and rapid it becomes impossible to comprehend. Increasing the playback speed, therefore, is not the way to compress speech.

Trimming Information

The way to effect VSC without affecting either the frequency response or the rate of speech is actually to remove small sections—snippets—of information. Research has shown that if minute bits of information are *randomly* removed from a string of words, the brain achieves from full to 80 percent comprehension—the exact degree of comprehension determined by the amount of information removed. In fact, early experimenters in speech compression *physically* removed the snippets when running their experiments. They would record a string of words on tape and edit random snippets with a razor blade.

Herb Friedman, c/o Tridec Electronics Corp., 588 Hewlett St., Franklin Square, NY 11010.

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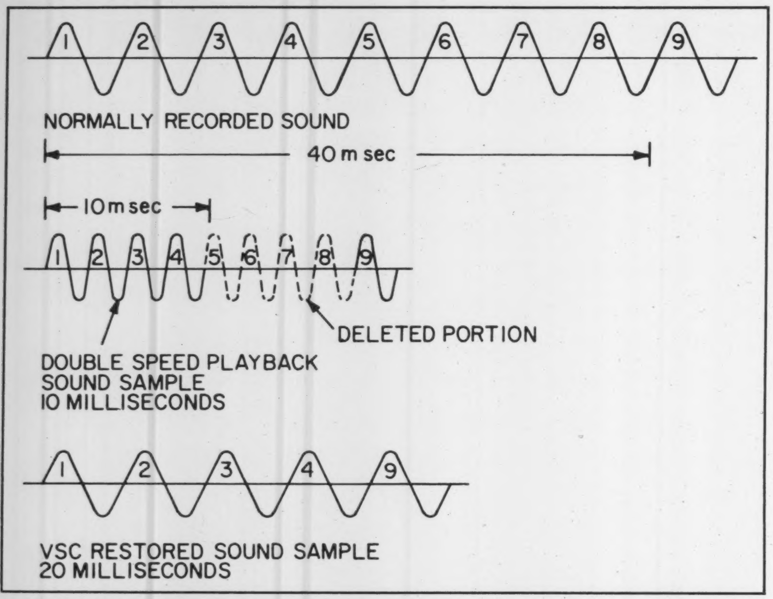

1
2
3
4
5
6
7
8
9
NORMALLY RECORDED SOUND
40 m sec
10 m sec
DELETED PORTION
DOUBLE SPEED PLAYBACK
SOUND SAMPLE
10 MILLISECONDS
VSC RESTORED SOUND SAMPLE
20 MILLISECONDS

Figure 1. VSC electronically removes part of the input signal in order to compress the signal. As shown, the input signal consists of 9 cycles in 40 msec. A X2 tape playback doubles the frequency and the VSC removes half of the signal, leaving only 10 msec. of information and a 10 msec. gap. The VSC then electronically stretches the signal to fill the gap, restoring the original input signal frequency, but now only 20 msec. is required for the input signal.

Now if snippets—no matter how small—are removed from the recording, the total length of time is reduced. If the snippets add up to 50 percent of the original tape length, the amount of time required to hear the edited tape is reduced by 50 percent, yet there is no apparent increase either in the rate of speech or the frequency range.

Even though the speech compresssion is 50 percent, the playback sounds natural to the listener. On the other hand, if we had attained 50 percent compression by *doubling* the playback speed of the original tape recording, the reproduction would sound like a chattering chipmunk.

In fact, VSC is so effective that it can be used for other things besides speech. As example, JVC uses the technique in their Vidstar model 6700 video cassette recorder (VCR) for a fast scan of the TV picture. Though the tape is running at a fast-wind speed the user can view a reasonable facsimile of the picture, rather than a "hash" of color streaks.

How It Works

Obviously, no one is editing every tape with a razor blade to make a VSC recording—certainly not video tape. Using digital technology and large scale integrated circuits, VSC is done electronically, and at a budget price. A complete VSC system can be packaged on a small printed circuit board, as shown in the photographs. In fact, a VSC system can be integrated within the cabinet of an ordinary portable cassette recorder, and the entire device can be retail priced at less than $200.

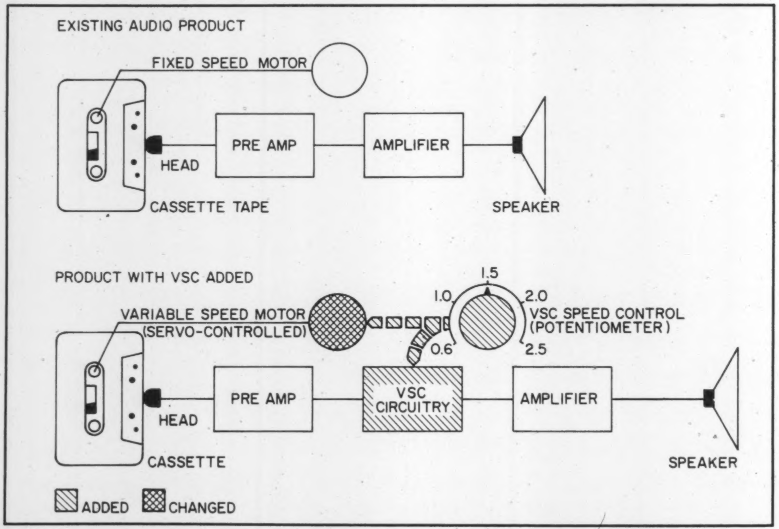
The first thing that is done to electronically reduce the playback time is to reproduce the cassette recording at a higher speed than it was recorded.

Let's assume that twice the speed is an X2 factor that doubles the pitch (frequency) of everything recorded on the tape. Next, we feed the X2 playback through a preamplifier and on to a VSC controller that removes snippets of the signal as shown in the chart diagram.

Note that for illustration we show cycles (from recorded tone) originally recorded in 40 milliseconds. On playback the eight cycles reproduce in 20 msec. The VSC controller electronically removes four of the eight cycles, leaving us with an electrical signal (still within the VSC) of four cycles, and a four cycle space, all utilizing 10 msec.

If we were to feed this signal out of a speaker it would sound like someone was strangling a chipmunk. Before the signal leaves the VSC, however, it is passed through a BBD, bucket brigade device that serves as a time delay which literally stretches the 10 msec. signal out to 20 msec. Whatever is left of the signal gets stretched back to its original frequency but the reproduction time now is only 20 msec., one-half the original recording time of 40 msec. The "stretch" fills in most of the gap between cycles four and nine; the remaining gap is extremely small and is not noticeable if the compression rate is 50 percent or less.

Now this might appear complex, or even incorrect at first reading, but if you re-read the foregoing while referring frequently to Figure 1, you will see that we have taken a signal that originated in 40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SPEAKER
PRODUCT WITH VSC ADDED
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(SERVO-CONTROLLED)
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1.0
2.0
0.6
2.5
VSC SPEED CONTROL
(POTENTIOMETER)
PRE AMP
VSC
CIRCUITRY
AMPLIFIER
HEAD
CASSETTE
SPEAKER
▨ ADDED
▩ CHANGED

Figure 2. In a complete cassette VSC system a single control adjusts both the VSC controller electronics and the tape drive motor's speed, insuring that the compressed speech will reproduce naturally. When the VSC restoration is not in sync with the tape drive speed the voice pitch can be adjusted to be bass, normal, or high pitched.

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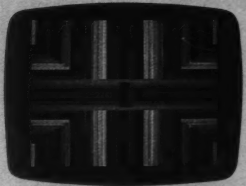

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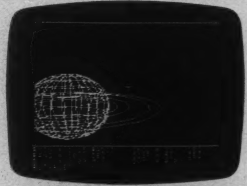

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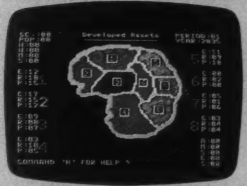

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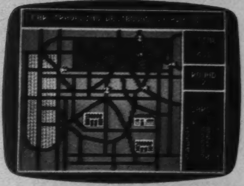

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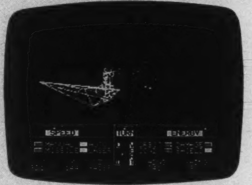

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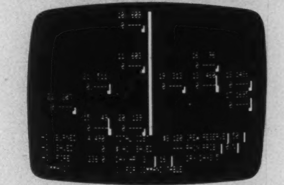

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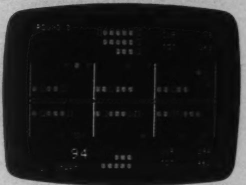

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Until now, the people who asked such questions tended not to be the same people who ran software companies. Instead, they were writers, filmmakers, painters, musicians. They were, in the traditional sense, artists.

We're about to change that tradition. The name of our company is Electronic Arts.

SOFTWARE WORTHY OF THE MINDS THAT USE IT. We are a new association of electronic artists united by a common goal — to fulfill the enormous potential of the personal computer.

In the short term, this means transcending its present use as a facilitator of unimaginative tasks and a medium for blasting aliens. In the long term, however, we can expect a great deal more.

These are wondrous machines we have created, and in them can be seen a bit of their makers. It is as if we had invested them with the image of our minds. And through them, we are learning more and more about ourselves.

We learn, for instance, that we are more entertained by the involvement of our imaginations than by passive viewing and listening. We learn that we are better taught by experience than by memorization. And we learn that the traditional distinctions — the ones that are made between art and entertainment and education — don't always apply.

TOWARD A LANGUAGE OF DREAMS. In short, we are finding that the computer can be more than just a processor of data.

It is a communications medium: an interactive tool that can bring people's thoughts and feelings closer together, perhaps closer than ever before. And while fifty years from now, its creation may seem no more important than the advent of motion pictures or television, there is a chance it will mean something more.

Something along the lines of a universal language of ideas and emotions. Something like a smile.

The first publications of Electronic Arts are now available. We suspect you'll be hearing a lot about them. Some of them are games like you've never seen before, that get more out of your computer than other games ever have. Others are harder to categorize — and we like that.

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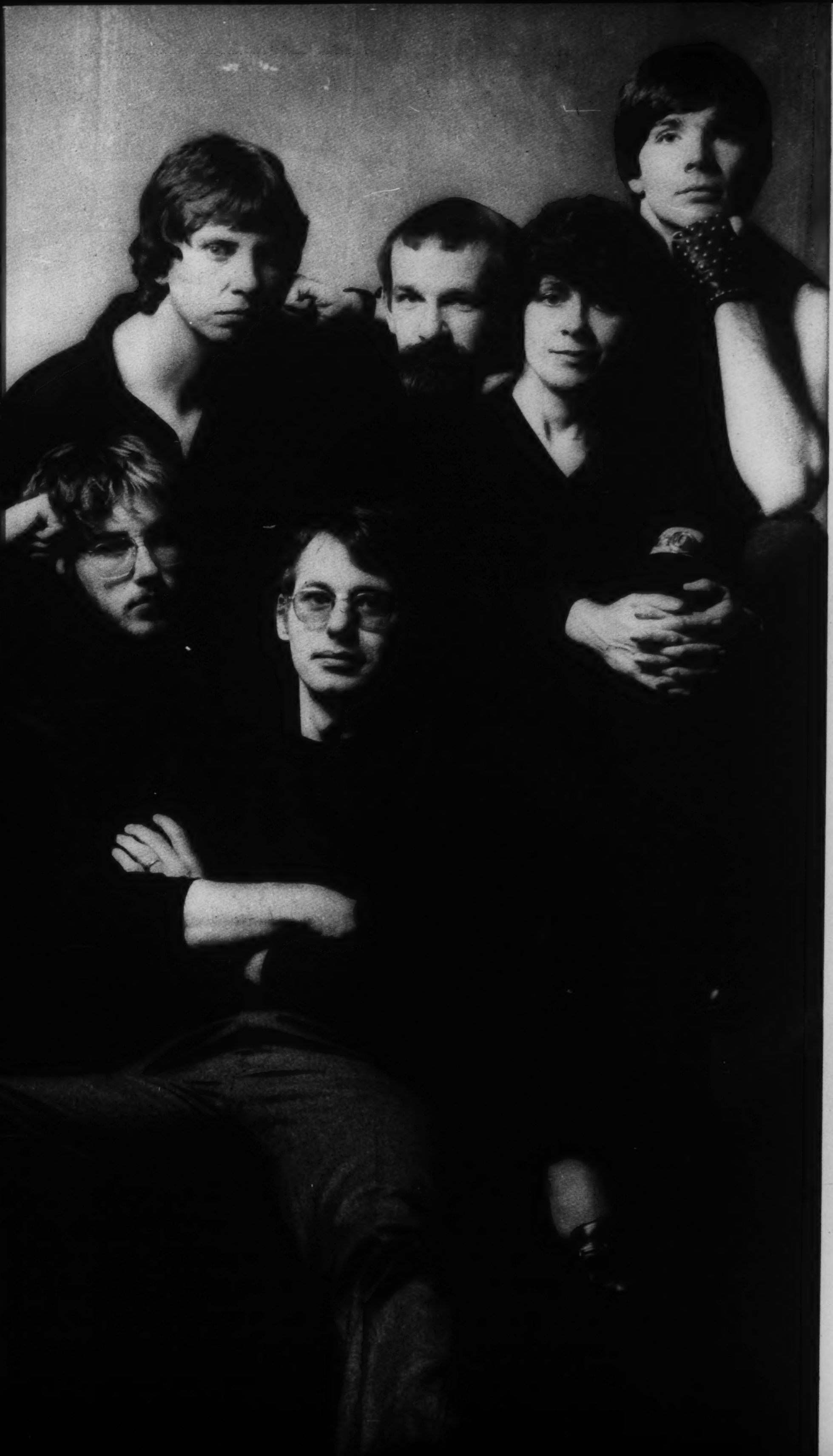

SOFTWARE ARTISTS? "I'm not so sure there *are* any software artists yet," says Bill Budge. "We've got to earn that title." Pictured here are a few people who have come as close to earning it as anyone we know.

That's Mr. Budge himself, creator of PINBALL CONSTRUCTION SET, at the upper right. To his left are Anne Westfall and Jon Freeman who, along with their colleagues at Free Fall Associates, created ARCHON and MURDER ON THE ZINDERNEUF.

Left of them is Dan Bunten of Ozark Softscape, the firm that wrote M.U.L.E. To Dan's left are Mike Abbot (top) and Matt Alexander (bottom), authors of HARD HAT MACK. In the center is John Field, creator of AXIS ASSASSIN and THE LAST GLADIATOR. David Maynard, lower right, is the man responsible for WORMS?

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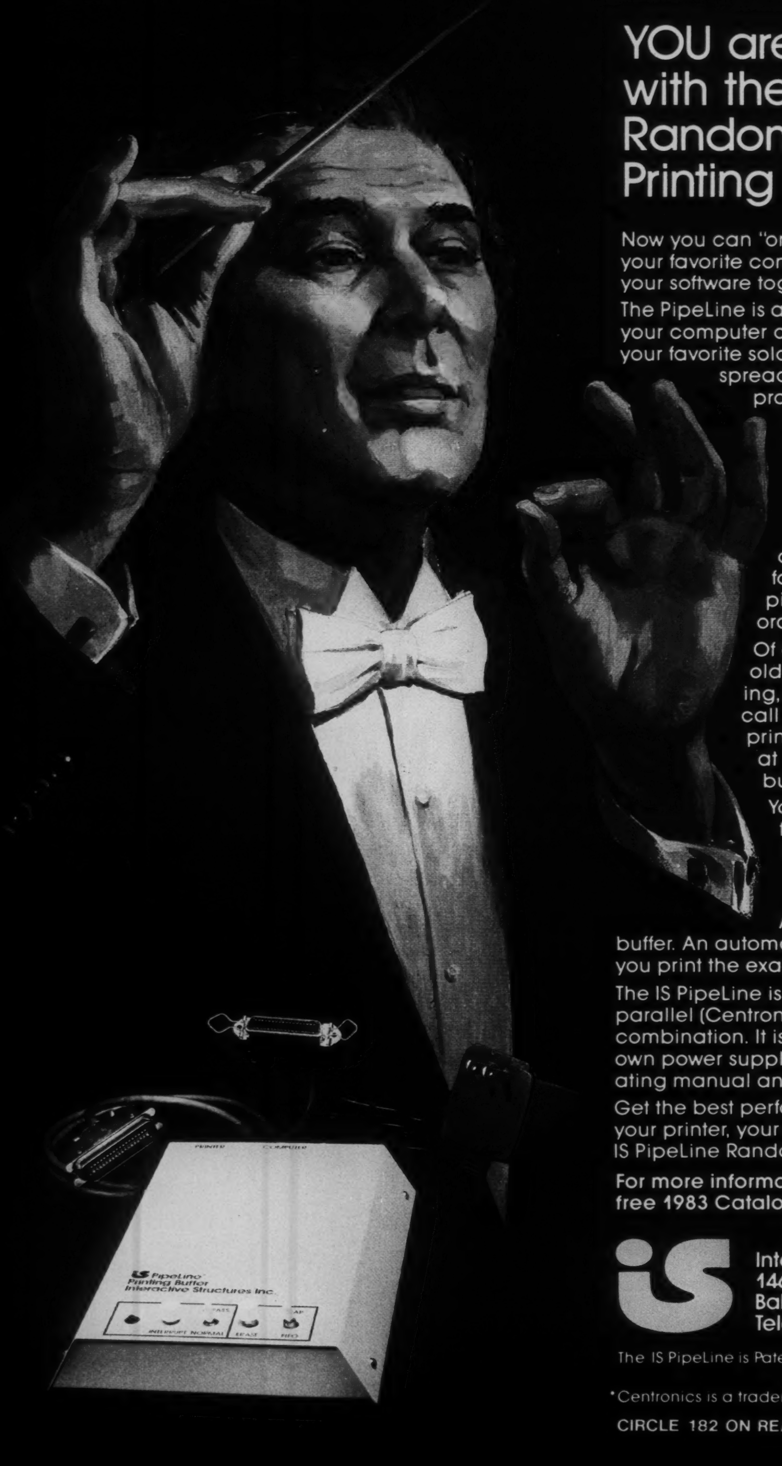

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Variable Speech, continued...

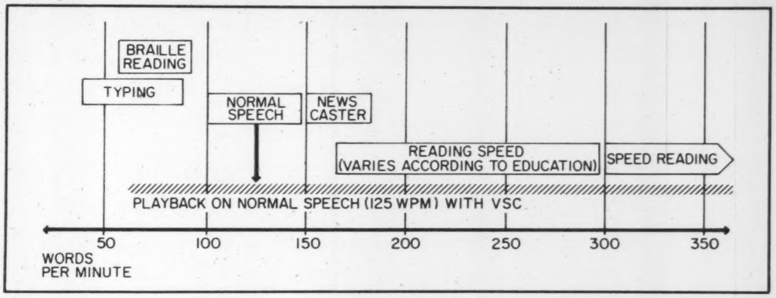

Figure 3. The above diagram compares the speeds of some common communication activities. VSC gives speech new flexibility by permitting slow down to match transcribing speeds or speed up to listen as fast as the average reading rate.

msec. and reproduced it at the same frequency in only 20 msec.

Imagine if you will an entire speech processed through the VSC. It too would be reproduced in half the time at the same rate of speech. No Donald Ducks, no chipmunks; just twice the information in half the time. Only if VSC is attempted at a factor greater than X2.5 would the speech become choppy, with a loss of comprehension.

Just as VSC can be used to compress speech, so too can it expand speech, up to 100 percent. In other words, if a speech takes 60 seconds to record, VSC can take up to 120 seconds to reproduce it. This time, instead of speeding up the tape, creating a gap, and then tightening up the gap, the tape is placed at, say, one-half speed, thereby *halving* the recorded frequencies. The VSC unit then eliminates half of each sample, creating a gap while restoring the original frequency.

At this point we have a restoration of the original waveform with gaps in between. The VSC then repeats the same waveform in the gap: in essence, everything is being repeated. The ear hears the original at the original speech rate, but now it takes twice as long to listen from beginning to end. Of what value is expanded speech? We'll get to that soon.

Servo Control

It should be obvious that the electronic frequency restoration of the VSC must in some way be tied to the increase (or decrease) in tape playback speed. After all, if the tape has been set for a X1.5 speed increase and the VSC is restoring the playback frequency at a X2.0 ratio the output sound is going to be very bassy. The problem is eliminated by simply tying the tape speed to the VSC restoration controller through a servo or "tachometer" cassette drive motor, similar to those used for high fidelity speed-controlled turntables. The motor has a built-in tachometer that sends a feedback signal to the VSC electronics.

The VSC compares the tacho feedback with its control signal to the drive motor and makes the necessary correction to insure the frequency restoration is directly proportional to the tape speed. If, for example, you are using a VSC Corp. Speech Controller cassette recorder, you will find a single control calibrated for a VSC rate of 0.6 to 2.5 sets both the cassette and decoder rates, which are interlocked. If one drifts slightly the other drifts the same amount, thereby maintaining frequency stability of the output sound (± 1%).

Talking Books

Earlier, we mentioned a use for expanded speech, which implies other uses than simply listening to an educational tape or a talking book. The same principle of voice expansion and compression can be used to change the pitch of an input signal, say to make it easier to understand the speaker.

For example, VSC can be used simply to lower or raise the pitch of a voice. This is easily accomplished by opening the servo lock between the drive motor of the recorder and the VSC. Then the controller of the VSC is used to move the sound up or down in frequency because the motor speed will not change as the VSC is adjusted.

Among the other uses for VSC are: film and video editing (for comprehensible audio during high speed scanning); high speed transmission of signals through limited bandwidth circuits (the signal can be "pushed" or moved into the most effective frequency range); time-compression of radio and TV announcements; movement of incoming sounds into an intelligible range for persons with frequency-selective hearing loss...and, well, the uses of VSC are limited only by your imagination.

For additional information on VSC products and a complete PC board assembly suitable for experimentation write to The Variable Speech Control Corp., 185 Berry St., San Francisco, CA 94107. □

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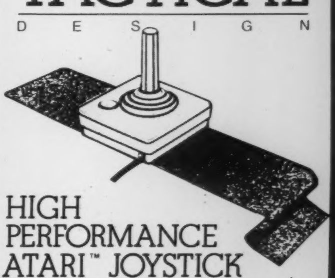

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A Layman's Guide To Disk Protection

Phillip Tubb

My company, ALF Products, is one of the few copying services in the U.S. for Apple-compatible floppy disks. Since I started this service, I have talked to several companies about the advantages and disadvantages of "copy-protected" or "copy-resistant" disk formats. And since ALF started advertising the copying service, mentioning our ability to copy disks with modified formats, several people have called asking if we can make back-up copies of copy resistant disks for them.

Our service is primarily mass duplication (at least 50 and up to several thousand of each disk) for software houses and peripheral manufacturers, so we can't help these individuals; but in talking with them I have picked up quite a bit of information.

I think we are all familiar with the customer's desire for software that can be backed up, thus providing him with lifetime access to the software. And we are equally familiar with the software companies' desire for software that isn't so easy to pirate.

So I'd like to touch on two other aspects of copy-resistant disks: the technical side, and some future marketing aspects. Since I am familiar only with disks compatible with the Apple computer, keep in mind that only some of this information will apply to other systems.

Technical Background

The Apple computer is well suited to copy-resistant disk formats. Those who aren't familiar with disk technology ask "If my Apple can read the disk, why can't my Apple Copy program copy it?"

The Apple disk drive design is rather simple, with most of the work being done by the software. The hardware allows a program to write a byte (eight bits) of data onto the disk, to read a byte from the disk, to turn the motor on and off, to position the read/write head at various places on the disk, and to select Drive 1 or Drive 2.

Because of certain technical aspects of magnetic recording, all bytes written to or read from the disk have a most significant bit of one, and no byte can have two or more zeros in a row with the 13-sector controller or three or more zeros in a row with the 16-sector controller.

Bytes are written to and read from the disk at a set rate which is hardware controlled and thus unchangeable (with one small exception). Since the disk makes one full rotation in 1/5th of a second (give or take some for motor speed variations), only a certain number of bytes can be written on a track (a track is one circle around the disk during which the read/write head remains the same distance from the center). Within these capabilities/limitations, the task of the software is to take a certain number of data bytes, normal bytes in which the most significant bit may be either a zero or a one and in which there may be up to eight zeros in a row, and write them onto the disk using the special bytes just described in such a fashion that they can later be read off the disk and reassembled in the original bytes.

Obviously, there are many, many ways to do this. The copy program Apple supplies with its disk drive is designed to work with one particular method. It will not copy disks which use any other method. Apple's drive controller card contains a small " boot-up" program in ROM which will read (and then run) a small program from a particular track on the disk if it is written in a particular fashion.

So, a certain number of bytes must be written onto this track in the Apple format or the disk will not boot. However, the small boot-up program on the disk can be any small program and still be compatible with the Apple ROM. Once loaded and running, this program can read the rest of the disk itself, and thus the remainder of the disk can be in any format.

If the Apple boot-up ROM can read this small program, so can any skilled programmer. He can then determine how it reads whatever it reads off the disk. Then he, too, can read whatever the program reads. By continuing to read and understand each program that is read off the disk, the programmer can eventually understand the entire disk format and know the data content of the disk.

Then he can modify the programs on the disk to function properly on a disk which is formatted in the standard way, thus creating a copy that can easily be copied. Or he can devise a program which will copy the entire disk, thus letting the programmer create as many copies as he desires, each of which is still as difficult to copy as the original. This

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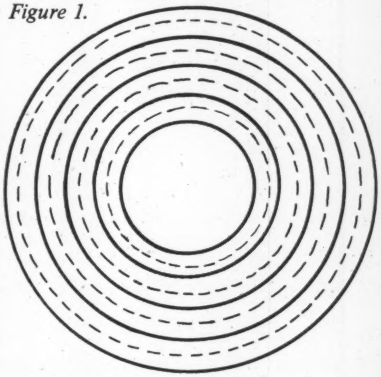
process can take much longer than it would take simply to write the program from scratch, or it may take only a few minutes.

Preferable would be a scheme to copy the disk without being concerned about how it is formatted or how programs work with the disk. It would seem that a "disk duplicator" could be built that would copy a disk as easily as a cassette tape duplicator seems to copy a tape. This never seems to work out. To understand why, let's consider a simple protection scheme.

On a standard Apple disk, data are written on 35 concentric circles called tracks; these tracks are numbered from 0 to 34 and are spaced about 1/48" apart.

Figure 1.



—data written
---possible head position

The solid lines in Figure 1 show a few of these tracks. Since the head positioning mechanism in the drive can position the read/write head in 1/96" increments, the dotted lines show possible track positions which are not used. (Attempting to use 1/96" track spacing would cause adjacent tracks to be erased or modified each time a track was written.) Positioning the head to these track positions is easy; the only difficulty is reading and reproducing the data on each track.

Drive Speed

Assuming the drive speed is exactly 300 rpm, there will be about 6378 bytes (special bytes, remember) of data. Now here is where the problems creep in.

When the disk to be copied is read, the number of bytes read will be the same as the number of bytes that were originally written. So if the drive was running, say, 1% fast when the disk was written there will be about 6314 bytes to read. Similarly, if it were running 1% slow, there would be 6442 bytes to read.

What then if the original drive was running 1% slow, and your drive is running 1% fast? How will you write 6442 bytes in 6314 bytes worth of time? You won't. Could the drive be adjusted to the same speed as the drive that wrote the original disk? No. To get the speeds within, say, one bit of each other would require an accuracy better than 0.002%, and drives normally vary more than ten times that amount from one revolution to the next, and well over 50 times that from one minute to the next, even under the best conditions.

The way this speed problem is overcome during normal copying is by varying the amount of unnecessary data scattered around the track and/or by putting a section of unnecessary data at one place on the track (where writing starts and stops). If the locations of these spots of data (or the location of one spot) are known, the drive speed is easily good enough to allow the track to be written while adding or removing only unnecessary data. In the Apple format, each of the 13 or 16 sectors is preceeded by a section of unnecessary data.

Since the object of easy copying is to eliminate the need to know anything about the contents of the particular disk being copied, the simplest programs written to copy copy-resistant disks are written on the assumption that certain "clues" will be available concerning the location of unnecessary data. In the vast majority of cases, these areas are easily found using simple program algorithms.

A hex byte of FF is almost universally used for such areas, due to technical aspects of disk reading. However, the situation is complicated by the fact that the 13-sector controller can also read and write an 8-bit byte followed by a single zero bit, and the 16-sector controller can read and write an 8-bit byte followed by one or two zero bits. These zero bits are not present when the disk is read, except as an almost undetectable difference in read-back speed.

Several techniques are used to make it difficult to find any of these key spots, or to mislead a copy program into treating a section as unnecessary when, in fact, it is part of the ordinary data. A more effective technique is to use a special copying program that reads each track (or perhaps only a few tracks) after the copy is made, then modifies the program on the disk. When the user runs the program, it can check to see if the number of bytes on each track is the same as when the disk was originally written. If not, the copy is illegal, and the program can erase the disk (and ask you to insert various other disks you have on hand, slyly erasing each one).

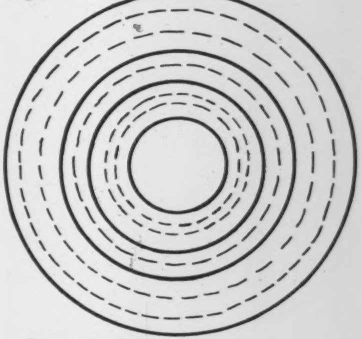
It is difficult, then, to copy a track. I am often asked if an analog system could be used to connect the read head from one drive to the write head of another. The speed problems still apply (to some degree even when using the single spindle, dual hub drives) as does the question of when to start and stop writing. (When writing is stopped, a small amount of magnetic garbage occurs.)

But the question is rendered meaningless due to shifts which occur in the magnetic data. The data read from a disk are not exactly the same as the data written on the disk. The controller is designed to process the data read from the disk until it looks like the data written on it. If this processing is not done, or is done improperly because the exact format of the track is not known, the shifting effect may become so large that the controller will not be able to read the copy.

Ways To Prevent Copying

Even assuming you could copy a track exactly, there are still ways to prevent copying. Figure 2 shows a popular scheme. You will notice that each track is still at least 1/48" away from every other track, but that they are not positioned at the same places as Apple tracks. Usually, fewer tracks are available on the disk when this scheme is used. Non-standard track spacings complicate copying disks even once you have a sufficiently versatile track-copying program running. However, it is obvious that the appropriate spacing can be deduced, or even found by trial and error.

Figure 2.

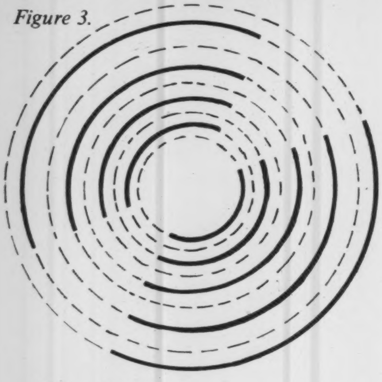


—data written
---possible head position

Now examine Figure 3. This is a scheme I have come up with to defeat the track spacing detectives. Each track is still 1/48" away from any other track at any given point. However, in any given circle around the disk there is a track less than 1/48" away. This format cannot be copied using a full-track copy program even if it has variable spacing capabilities. It has the disadvantage of a lower total storage capacity, like most track spacing schemes, and it is difficult to make in the first place.

By now you have realized that anyone who understands how the system works can, with a little imagination, come up

Figure 3.



—data written
---possible head position

with new ways to defeat general purpose copy programs. Due to the high data rates involved (and thus the small amount of processor time available), very small effects can be used. I see no end to the battle between copy-resistant formats and special copy programs to defeat them.

In a general sense, any format for which the master disk is the same as the copies produced can be copied—a program like the program that did the copying in the first place will do. However, if the copy is different in some way from the master, it may be that no program can copy the disk unless the program on the disk is understood. An example of this is the program that, when run, checks each track to determine what the disk speed was when the copy was produced. Each copy will be different, because the speed during copying will vary at each revolution; and each program will be modified to function with the exact speed that occurred.

To sum up, a key question is "Can a program be developed that defeats all formats?" My answer is "no." While such a program (or a special machine) may, in fact, be possible, it seems very unlikely today.

Future Marketing

I am suggesting that disks which the customer is unable to copy will continue to be possible. But will they remain practical? There is growing rebellion among consumers. Two factors strike me as important.

First, any program that can be written once can be written again. If you are annoyed that you can't copy *VisiCalc* (to pick just one example), so is someone else. And that someone else may be a programmer who sees writing *VisiCalc* as an afternoon's effort. Soon, WonderSoft is selling *Opticalc* which is not only copyable, but sells for $25 less! Are there big bucks to be made in writing programs (new programs, done from scratch) that have the same features as programs on copy-resistant disks, marketed on standard format disks? My guess is yes, and it is completely legal. Most people consider ethical as well, although some disagree.

Second, there is much talk about hard disks. In fact, there is much talk about several new storage devices. Many of these have fixed media but large capacity. If these become more popular, as many people are sure they will, floppy disks may increasingly be a convenient and inexpensive method for getting software from the vendor to the customer. But the customer will then want to transfer the program immediately to his MegaStore which is fast and convenient. How will the customer do this with copy-resistant disks? Probably by buying *Opticalc* from WonderSoft.

Records, cassettes, eight-tracks, radio and television broadcasts—all these are easily duplicated to the satisfaction of the listener/viewer. Yet these industries still exist, despite complaints that all are suffering greatly from illegal pirating. Perhaps it is time the software industry found out how they're doing it. ☐

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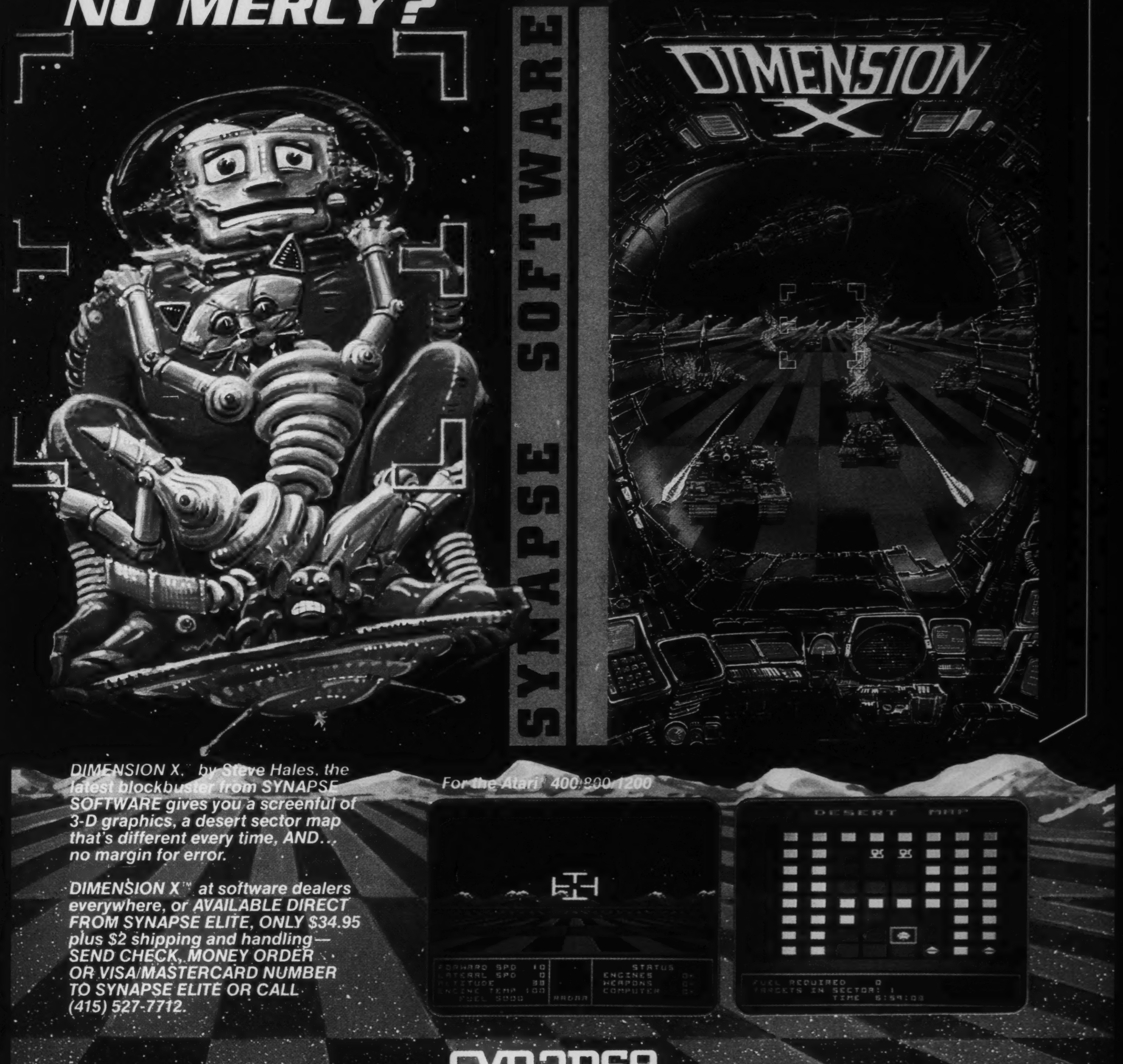

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```

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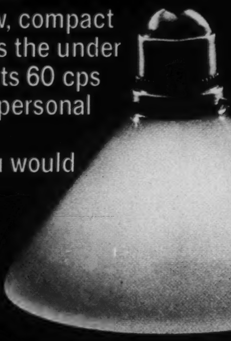

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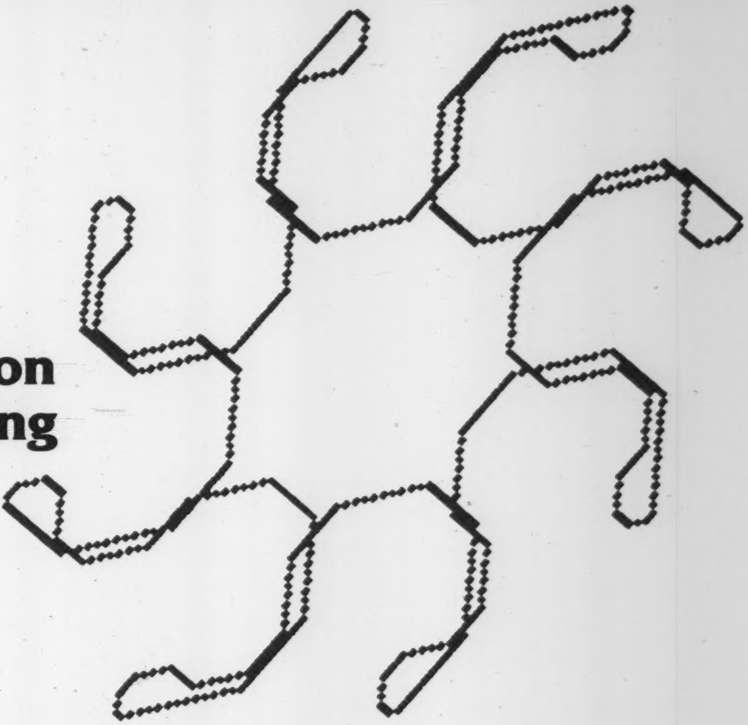


Medium Resolution Line Printer Plotting

Kimball M. Rudeen

While I am usually perfectly satisfied with my TRS-80 Model III, I sometimes wish the graphics were a little better. There are times when I could do with a better aspect ratio or smaller pixels or a work space larger than 128 x 48. This article describes a method I have found for reaching these goals using a line printer with graphic character capacity.

As most people who have such a printer will know, it is simple to copy a screen display onto paper. I use a simple PEEK loop that reads the TRS-80 screen memory character by character and prints each character using the CHR$ function. My printer, an Okidata Microline 82A, has maximums of 16.5 characters per inch and 8 lines per inch. Given the 2 x 3 pixels per character of the TRS-80, this means a printed pixel of about .03” x .04”. This is quite an improvement in aspect ratio and resolution, but there is still the 128 x 48 work space limit.

The PEEK loop I use to copy the screen picture suggested an interesting possibility. This loop treats the TRS-80 screen as a linear array in memory, with each entry containing a byte of data defining six pixel locations. A similar loop could be used to store a screen picture in a 2D array, or to reproduce a picture so stored.

Consider an N x M array, with each entry able to contain a byte or more of data. Since TRS-80 graphic character codes can be stored in this array, it could also be thought of as a 2N x 3M pixel array. If N > 64 and M > 16, the work space provided by this array exceeds the TRS-80 screen space.

> ***There are times when I could do with a better aspect ratio or smaller pixels or a work space larger than 128 x 48.***

The method I have developed makes it possible to address single pixels directly in such an array. It enables a program to translate an x,y location and the character code that will turn the pixel matching that location on.

The best way to describe this method is to state the problems it must solve. Given an x,y location and a N x M array, it is necessary to:

- Determine which entry in the array contains the pixel corresponding to the x,y location.
- Determine the character code that will turn that pixel on in a printout.
- Load that character code into the array entry without disturbing any pixels already set.

The first problem can be solved very simply. Each entry in a row of N array entries contains two columns of pixels for a total of 2N columns. The x location of a pixel specifies the column containing it. If these columns are numbered 0 to 2N-1, then an integer division of x by 2, or INT(X/2), will generate a number from 0 to N-1. This number gives the entry in a row of N entries containing the pixel with the given x coordinate.

Similarly, the function INT(Y/3) will identify the entry in a column of M array entries that contains the pixel with a given y coordinate. So, given the N x M array and an x,y pixel location, the functions INT(X/2) and INT(Y/3) will specify the array entry containing the pixel.

The second problem is a bit more complex (pun intended). The basic TRS-80 graphics character code is 128 for a blank space with no pixels set. The six pixels in a character block are set by turning on bits 0 to 5 in addition to bit 7 (128 in binary). Figure 1 illustrates the binary values of the bit positions corresponding to each of the six pixels.

Kimball M. Rudeen, 35 Lowell St., Lexington, MA 02173.

Medium-Res Plotting, continued...

The problem becomes one of converting an x,y location into the bit position for that pixel within its array entry. Consider again the value generated by INT(X/2). This gives the integer result of X divided by 2. The function X-2*INT(X/2) generates the missing remainder, which is 0 if X is a multiple of 2, or 1 if X=2P+1 for some integer P. But X is a multiple of 2 if X is in the first pixel column of some character position, and X=2P+1 for some P if X is in the second column. Similarly, the function Y-3*INT(Y/3) gives 0, 1 or 2 for Y in the top, middle, or bottom pixel row of a character position. Figure 1 illustrates this as well.

Let BX=X-2*INT(X/2) and BY=Y-3*INT(Y/3). Then the function BP=BX+2*BY will return the six values 0 to 5 when given the BX, BY coordinates of the six locations, and therefore specifies the bit position to turn that pixel on. This solves the second problem.

Now the third problem: given the array entry and the position of the bit to be set, set that bit without changing any other bit settings. Given an integer variable, a single bit in that variable can be set by the OR function. If the integer variable is ORed with another variable containing the proper power of 2, the chosen bit will be set. The quickest and most reliable way I have found to do this is to use an array containing the powers of 2 from 0 to 5, indexed by the function BP=BX+2*BY. The indexed entry can be ORed into the array entry to set the specified bit.

To sum up, given an x,y pixel location to be set in an M x N array:

- Use the functions PX=INT(X/2), PY=INT(Y/3) to locate the array entry containing the pixel.
- Use the functions BX=X-2*PX, BY=Y-3*PY, and BP=BX+2*BY to determine the bit position to be set to turn the pixel on.
- OR the PX,PY array entry with BP of an array containing the powers of 2 in the order illustrated in Figure 1.

Figure 1.

	0	1
0	1	2
1	4	8
2	16	32

```
100 A=64:B=24:X=A:Y=B
110 LM=0:RM=128:TM=0:BM=48
120 INPUT "ENTER A STRING";N$:N=LEN(N$)
130 D1=1:D2=0:LM=1:CLS
140 FOR I=1 TO N
150 S=ABS(D1)+ABS(D2):T1=D1:T2=D2
160 IF MID$(N$,I,1)="R" THEN D1=(T1-T2)/S:D2=(T1+T2)/S
170 IF MID$(N$,I,1)="L" THEN D1=(T1+T2)/S:D2=(T2-T1)/S
180 FOR J=1 TO I
190 FOR K=1 TO LM
200 X=X+D1:Y=Y+D2
210 IF X>=LM AND X<RM AND Y>=TM AND Y<BM THEN SET(X,Y)
220 NEXT K:NEXT J
230 NEXT I
240 IF X=A AND Y=B THEN END
250 GOTO 140
```

Listing 1.

```
10 MX=127:MY=63                       ' SET WORK SPACE DIMENSIONS
20 DIM PT%(MX,MY),BIT%(5)             ' CREATE WORK SPACE, BIT ARRAYS
30 FOR I=0 TO 5:READ BIT%(I):NEXT     ' INITIALIZE BIT ARRAY
40 DATA 1,2,4,8,16,32
100 A=152:B=40:X=A:Y=B                ' CHANGE INITIAL POSITION
110 LM=0:RM=255:TM=0:BM=191           ' CHANGE MARGINS
120 INPUT "ENTER A STRING";N$:N=LEN(N$)
130 D1=1:D2=0:LM=1
140 FOR I=1 TO N
150 S=ABS(D1)+ABS(D2):T1=D1:T2=D2
160 IF MID$(N$,I,1)="R" THEN D1=(T1-T2)/S:D2=(T1+T2)/S
170 IF MID$(N$,I,1)="L" THEN D1=(T1+T2)/S:D2=(T2-T1)/S
180 FOR J=1 TO I
190 FOR K=1 TO LM
200 X=X+D1:Y=Y+D2
210 IF X>=LM AND X<RM AND Y>=TM AND Y<BM THEN GOSUB 500 ' ***
220 NEXT K:NEXT J
230 NEXT I
240 IF X=A AND Y=B THEN GOSUB 1000: END                 ' ***
250 GOTO 140
490 ' PIXEL SETTING SUBROUTINE
500 PX=INT(X/2):PY=INT(Y/3):BX=X-2*PX:BY=Y-3*PY
510 PT%(PX,PY)=PT%(PX,PY) OR BIT%(BX+2*BY)
520 RETURN
990 ' PRINTOUT SUBROUTINE
1000 FOR DY=0 TO MY
1010 FOR DX=0 TO MX
1020 IF PT%(DX,DY)=0 THEN LPRINT CHR$(128);:GOTO 1040
1030 LPRINT CHR$(PT%(DX,DY)+128);:PT%(DX,DY)=0
1040 NEXT DX:LPRINT
1050 NEXT DY
1060 RETURN
```

Listing 2.

After all array entries have been set, the array can be printed out. In this method, the array is scanned left to right, top to bottom. If an entry is empty, it is added to 128 to create a graphics character code. The CHR$ function is then used to print out the character. This saves the trouble of initializing all array entries to 128.

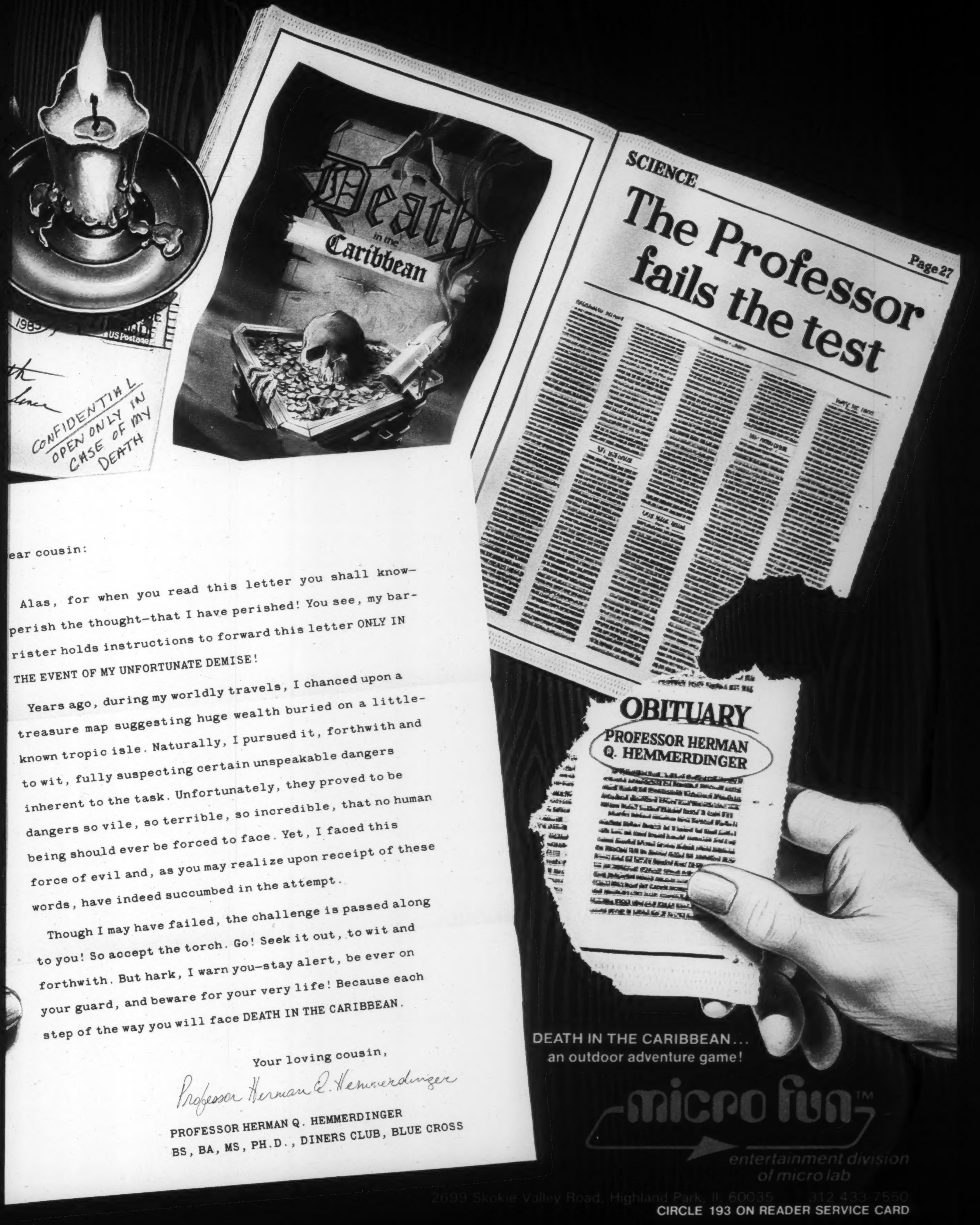
The Programs

Listing 1 is a program for generating Spirolateral figures, as described by Donald T. Piele in the March and April 1982 issues of *Creative Computing*. I found that the figures generated by this program were either too large to fit on my screen, or made no sense when displayed in TRS-80 low-resolution graphics.

Listing 2 is the same program with additions and modifications to plot into and display from an internal array. Lines 10-40 define the internal array PT% with a 256 x 192 pixel space, and initialize the pixel setting array BIT%. Lines 210 and 240 have been modified to call the pixel setting and printout subroutines. These subroutines are contained in lines 500-520 and 1000-1060 respectively. The original program was modified in only two places. The rest of the code was added.

Figure 2 is a Spirolateral figure generated by this program from the input string RRRRRLLLRRRRR. This same plot was too large to fit on my TRS-80 screen when generated by the Listing 1 program.

Some readers may have noticed a major drawback to this method as implemented in Listing 2. The 128 x 64 integer array PT% requires more than 16K bytes of memory—too much for a 16K TRS-80. This is due to a very inefficient storage system. Only the first six bits of each 16 bit integer array entry are used to store data.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ear cousin:

Alas, for when you read this letter you shall know—perish the thought—that I have perished! You see, my barrister holds instructions to forward this letter ONLY IN THE EVENT OF MY UNFORTUNATE DEMISE!

Years ago, during my worldly travels, I chanced upon a treasure map suggesting huge wealth buried on a little-known tropic isle. Naturally, I pursued it, forthwith and to wit, fully suspecting certain unspeakable dangers inherent to the task. Unfortunately, they proved to be dangers so vile, so terrible, so incredible, that no human being should ever be forced to face. Yet, I faced this force of evil and, as you may realize upon receipt of these words, have indeed succumbed in the attempt.

Though I may have failed, the challenge is passed along to you! So accept the torch. Go! Seek it out, to wit and forthwith. But hark, I warn you—stay alert, be ever on your guard, and beware for your very life! Because each step of the way you will face DEATH IN THE CARIBBEAN.

Your loving cousin,

Professor Herman Q. Hemmerdinger

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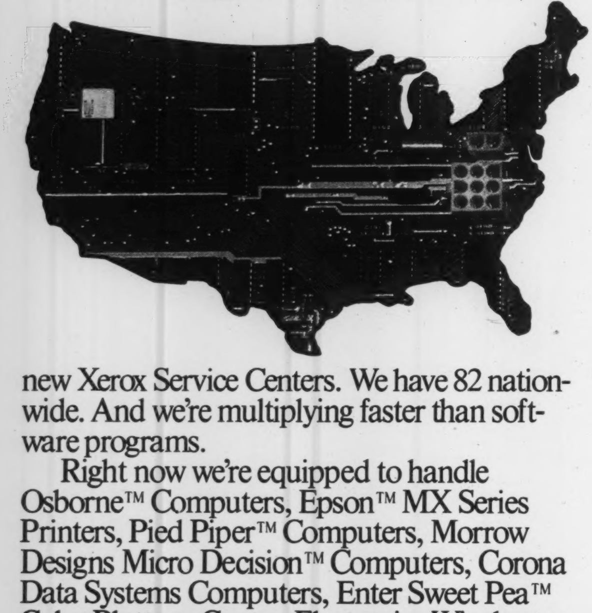

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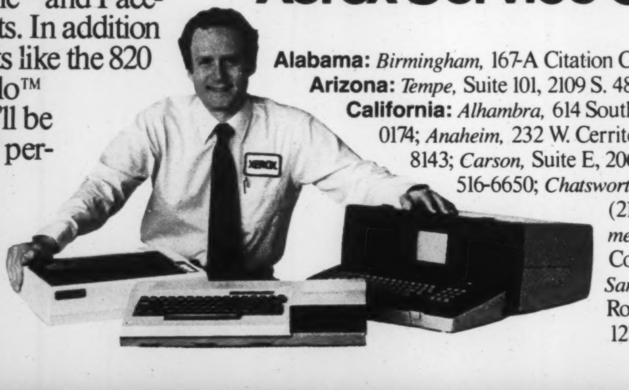

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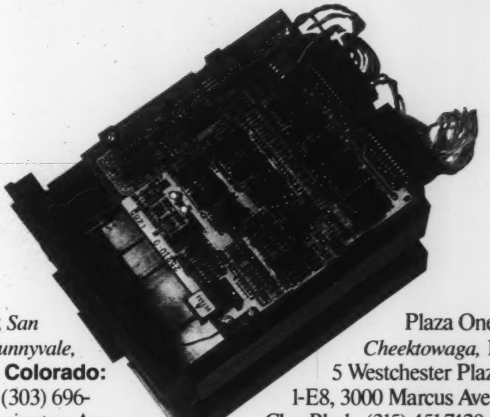

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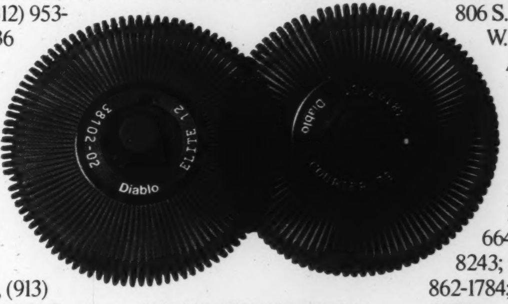

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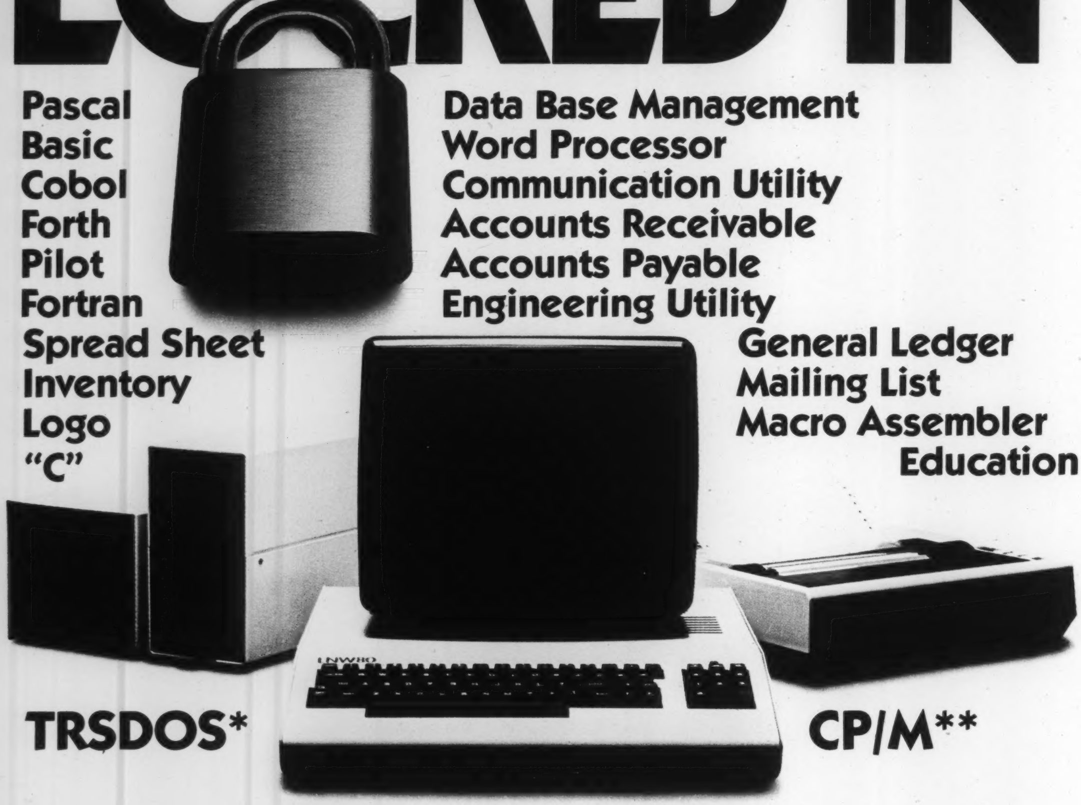

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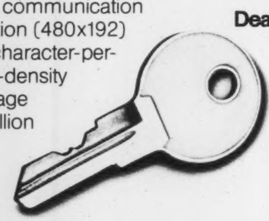

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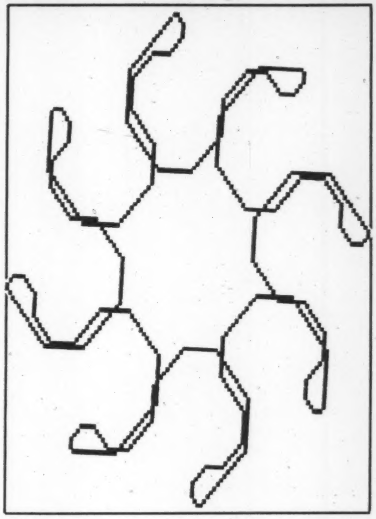

Figure 2.

```
10 MX=63:MY=63                          ' NEW WORK SPACE DIMENSIONS
20 DIM PT%(MX,MY),BIT%(11)              ' CREATE WORK SPACE, BIT ARRAYS
30 FOR I=0 TO 11:READ BIT%(I):NEXT      ' INITIALIZE BIT ARRAY
40 DATA 64,128,1,2,256,512,4,8,
   1024,2048,16,32
100 A=152:B=40:X=A:Y=B                  ' CHANGE INITIAL POSITION
110 LM=0:RM=255:TM=0:BM=191             ' CHANGE MARGINS
120 INPUT "ENTER A STRING";N$:N=LEN(N$)
130 D1=1:D2=0:LM=1
140 FOR I=1 TO N
150 S=ABS(D1)+ABS(D2):T1=D1:T2=D2
160 IF MID$(N$,I,1)="R" THEN D1=(T1-T2)/S:D2=(T1+T2)/S
170 IF MID$(N$,I,1)="L" THEN D1=(T1+T2)/S:D2=(T2-T1)/S
180 FOR J=1 TO I
190 FOR K=1 TO LM
200 X=X+D1:Y=Y+D2
210 IF X>=LM AND X<RM AND Y>=TM AND Y<BM THEN GOSUB 500  ' ***
220 NEXT K:NEXT J
230 NEXT I
240 IF X=A AND Y=B THEN GOSUB 1000 : END                 ' ***
250 GOTO 140
490 ' PIXEL SETTING SUBROUTINE                           ' ***
500 PX=INT(X/4):PY=INT(Y/3):BX=X-4*PX:BY=Y-3*PY
510 PT%(PX,PY)=PT%(PX,PY) OR BIT%(BX+4*BY)
520 RETURN
990 ' PRINTOUT SUBROUTINE                                ' ***
1000 FOR DY=0 TO MY
1010 FOR DX=0 TO MX
1020 IF PT%(DX,DY)=0 THEN LPRINT CHR$(128)+CHR$(128);:
     GOTO 1060
1030 IF PT%(DX,DY) AND 4032 THEN PT%=INT(PT%(DX,DY)/64):
     LPRINT CHR$(PT%+128); ELSE LPRINT CHR$(128);
1040 IF PT%(DX,DY) AND 63 THEN
     PT%=PT%(DX,DY)-64*INT(PT%(DX,DY)/64):
     LPRINT CHR$(PT%+128); ELSE LPRINT CHR$(128);
1050 PT%(DX,DY)=0
1060 NEXT DX:LPRINT
1070 NEXT DY
1080 RETURN
```

Listing 3.

Fortunately there is a way to extend this method and double data storage. A second 2 x 3 pixel array can be stored in bits 6 to 11 of an integer array entry. An N x M integer array now becomes a 4N x 3M pixel array. Figure 3 illustrates the bit positions for this new coding. Notice that each entry in the left 2 x 3 pixel set is equal to the corresponding entry in the right pixel set *64, or shifted six bits to the left.

The coordinates of the array entry of a pixel at x,y are now given by PX=INT(X/4) and PY=INT(Y/3). Only the X function is changed. Similarly, the bit positions are now given by BP=BX+4*BY for BX=X-4*PX and BY=Y-3*PY. The BIT% array now contains twelve entries, initialized according to the bit positions shown in Figure 3.

The most complicated change is unpacking this new coding for printout. Each entry now contains two characters, in bits 6-11 and 0-5. These two-bit sets must be unpacked separately. Listing 3 is Listing 2 converted to double storage. The array initializations and pixel setting subroutine have changed as described above. The printout function now prints two spaces for every empty array entry. If an entry is not empty, it is unpacked in two stages.

First, the entry is ANDed with the integer 4032, which in binary is 111111000000. If anything is stored in bits 6-11, the test condition is true and the entry is divided by 64 to shift bits 6-11 to positions 0-5. The entry is then decoded and printed out.

		1	2	3
0	64	128	1	2
1	256	512	4	8
2	1024	2048	16	32

Figure 3.

"Wow, George... your graphic matrix simulations are starting to approach reality!"

Next, the entry is ANDed with the integer 63, which in binary is 000000111111. If anything is stored in bits 0-5, the contents of bits 6-11 (if any) are stripped off and the remaining bits in positions 0-5 are decoded and printed out.

Any program using the SET function could be converted to use this method. If memory is tight, the internal graphics array could be cut down quite a bit and still be an improvement on a screen display. In addition, the bit manipulation method I have described could easily be used to create subroutines to replace the RESET and POINT functions. Given all of these subroutines and the proper line printer, TRS-80 graphics are no longer limited to the screen. ☐

Line Drawing Routines for the TRS-80

Richard Wagner and Frederick Wagner

Despite its many good features, the TRS-80 is rather unfriendly about drawing lines on its display screen. Many other home computers have nifty graphics commands in Basic. They compute and plot line segments with lightning speed. About the best you can do with Level II TRS-80 Basic is SET (turn on) and RESET (turn off) individual points or pixels.

The TRS-80 user is thus forced to write special programs or routines for plotting lines. Such programs can be complicated as well as slow.

If the TRS-80 had good built-in line drawing routines you could easily put borders around text output, do simple stick figure animation, draw large or specially-shaped letters, and even draw maps or dungeon rooms for an adventure game. Take heart! The accompanying Basic program incorporates a machine language routine that provides excellent line drawing capabilities.

First, we will discuss the problem of plotting lines in general. The principles involved are essentially the same for all computers that plot lines as a series of individual points on a rectangular display. Our goal will be to compute and plot a string of points representing a desired line, such that:

- The line accurately connects the endpoints, with no gaps between individual pixels (This objective is fairly easy to meet).
- The line appears to be straight and to have uniform density with no bunched-up points (This one is harder, unless the pixel size is very small—hardly the case with the TRS-80).

When we try to satisfy these goals we run into the problem of display screen resolution. That is, we may find few pixel positions on the display screen that fall exactly on the true (calculated) path of the line. In fact, truly straight lines are impossible to draw unless one of two conditions applies:

- The line is horizontal or vertical.
- The endpoint separation (in pixels) in both the horizontal and vertical directions is the same.

Thus, most diagonal lines exhibit a "stair step" effect.

This becomes increasingly apparent with larger pixel sizes, and TRS-80 pixels are pretty large. Figure 1 illustrates the problem, and Figure 2 shows what happens if poor line drawing methods are used. (The technical name for the stair step appearance is "aliasing." It can occur whenever the display screen resolution is less than that of the object being displayed. Sophisticated display screen hardware can compensate by "ramping" or smoothing out the steps.)

Please note that our diagrams ignore another unpleasant fact about TRS-80 graphics. That is the fact that the horizontal and vertical scales are quite different, so that the individual pixels aren't square. However, this does not affect the way in which lines are plotted.

Bresenham's Algorithm

There are several point plotting methods that do a fairly good job. One of them, Bresenham's algorithm, is very useful in assembly language programming. Only integer arithmetic is used, and there are no divides. The only multiplies are by 2, implemented by simple SHIFT operations.

Listing 1 is a Basic program derived from Bresenham's line drawing algorithm. It runs slowly, taking one or two seconds to plot each line, but does help to expose the workings of the algorithm.

Bresenham's method draws fairly presentable lines by ensuring that the stair steps in diagonal lines are evenly spaced. It does this by maintaining an "error term" (variable E) which is initialized with a negative value. E is a measure of the distance between a plotted pixel and the exact path of the line. The plotted position must, of course, fall on an exact display screen coordinate position, whereas the true path of the line may rarely do so (see Figure 3).

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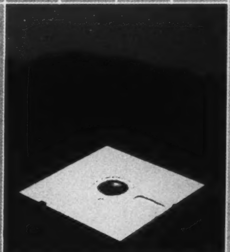

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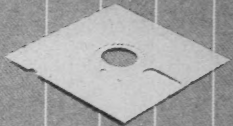

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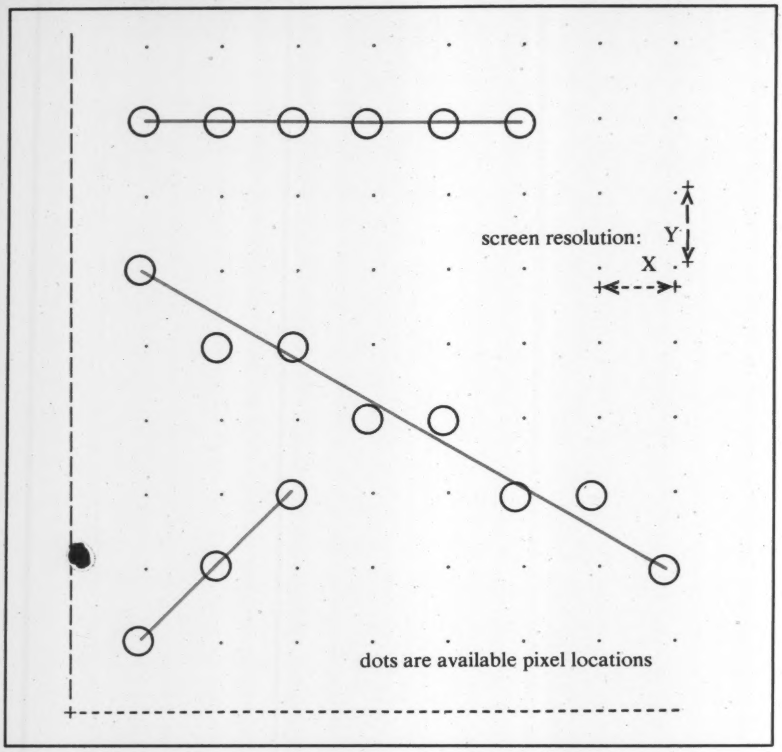

Figure 1. Calculated lines (in red) vs. actual points plotted (in green).

The error term E is initialized at a value related to the horizontal and vertical distances involved. An increment value EI and a decrement value ED are also computed. All these values are adjusted in a proportional manner so as to avoid having to use fractional values. (Fractional values would require use of single-precision numbers instead of integers, greatly slowing up the calculations.)

Assume we are plotting a line from point (X1, Y1) to (X2, Y2) and that the distance to plot is greater in the horizontal or X direction. The unit change in X (variable IX) is set to 1 unless X1 is larger than X2, in which case it is set to –1. The value of IY is determined in the same manner. As each point (X,Y) is plotted, the current value of E is tested; if it is greater than zero, Y is incremented by IY and E is decremented by ED back to a negative value. Otherwise E is incremented by EI.

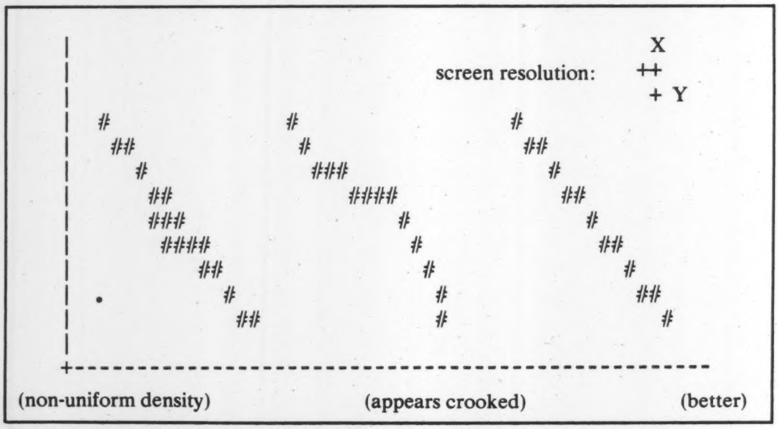

Figure 2. Lines should look straight, with uniform density.

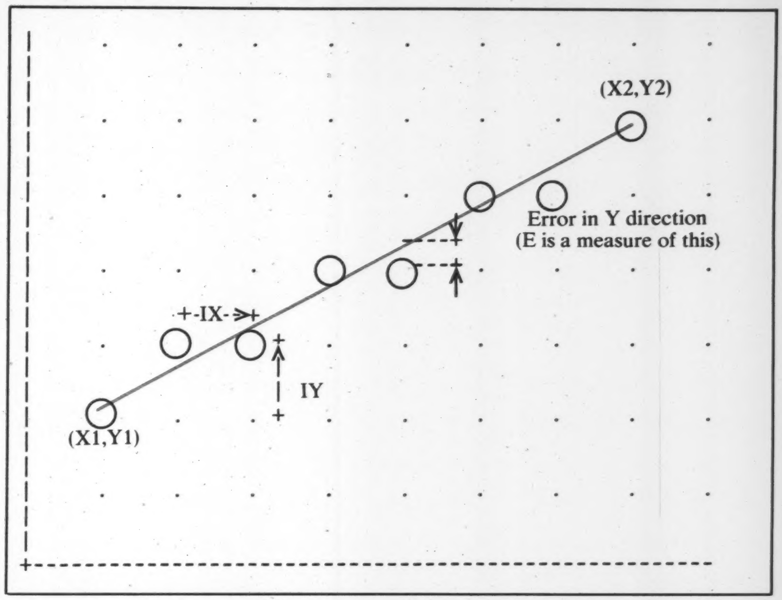

Figure 3. Bresenham's "error term."

X is always incremented by IX after each point is plotted. With properly computed values for EI and ED we are assured of evenly spaced steps in the plotted line. When the distance to plot is greater in the vertical direction (Y) the procedure works in a similar manner, substituting Y for X, IY for IX, etc.

Fastdraw-80

Listing 2, Fastdraw-80, is a Basic program that builds and executes an assembly language implementation of Bresenham's algorithm. It both draws and erases lines. Various tests are included to ensure that plotting stays within the display screen boundaries. We shall call the assembly language routine Quikplot for convenience, since it can be used independently of the Basic program that builds it. Fastdraw-80 demonstrates a simple method one of us

Listing 1.

```
10 REM * * * * * * *  BRESENHAM - 80  * * * * * * *
20 REM
30 REM RICHARD J. WAGNER
40 REM 11920 N. W. OATFIELD CT., PORTLAND, OR 97229
50 REM JULY 15TH, 1982
60 REM
70 REM AN INTEGER-MATH, NO-DIVIDE ROUTINE THAT COMPUTES
80 REM AND DRAWS A "STRAIGHT" LINE CONNECTING TWO END
90 REM POINTS (X1,Y1) AND (X2,Y2). ROUTINE ENSURES
100 REM THAT ONLY "LEGAL" POINTS ARE PLOTTED, E.G.,
110 REM LX<=X<=HX AND LY<=Y<=HY WHERE LX = MIN X VALUE,
120 REM HX = MAX X VALUE, ETC.
130 REM
140 REM FOR THE TRS-80, USING THE FULL SIZE OF THE CRT AS
150 REM A "WINDOW", THE FOLLOWING LIMITING VALUES APPLY:
160 REM          LX=0  HX=127  LY=0  HY=47
170 REM
180 REM THIS ROUTINE WAS DERIVED FROM J. E. BRESENHAM'S
190 REM "ALGORITHM FOR COMPUTER CONTROL OF A DIGITAL
200 REM PLOTTER", P. 26, PRINCIPLES OF INTERACTIVE
210 REM COMPUTER GRAPHICS, W. M. NEWMAN AND R. F. SPROUL,
220 REM MCGRAW-HILL BOOK CO., 1979.
230 REM
240 REM THE NUMBER OF POINTS FORMING THE LINE WILL BE
250 REM EQUAL TO THE GREATER OF THE DIFFERENCE BETWEEN
260 REM X1 AND X2 AND THE DIFFERENCE BETWEEN Y1 AND Y2.
270 REM
280 REM THE POINTS ARE PLOTTED SO THAT THE CHANGE IN THE
290 REM DIRECTION OF LEAST DIFFERENCE IS MADE IN EVENLY
300 REM SPACED STEPS; THE RESULTING LINE THUS WILL APPEAR
```

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(Frederick) developed to encode assembly language routines within Basic programs.

The assembly language routine is developed with the aid of a standard Z80 reference book, and, if available, an Editor-Assembler program. The hex code for the routine is entered as the values of one or more string variables (lines 1010-1050). An initialization routine (lines 1060-1080) is called to convert the hex characters into integers and to POKE them into reserved memory. (A more conventional but far less user-friendly method is to load the assembly language programs from separate files before loading the Basic program. Frederick's method requires only a single LOAD or RUN command.)

Fastdraw-80 requires 32K RAM, and should work on either the Model I or Model III TRS-80. The program can be used with either regular Level II or disk Basic. For non-disk Basic, the USR function call must be changed as described in the remarks of Listing 2.

A demonstration routine is included in Fastdraw-80. It will verify that you have coded the program correctly, and show some of the potential of Quikplot. The demonstration includes a moving pattern and shows how to use the erase feature to draw black lines on a white background. I must admit I was surprised at how fast lines are drawn and with the neat animation effects; who ever thought our TRS-80 could do such tricks?

The Quikplot routine expects to find the number of lines to draw and the coordinates of their endpoints in a two-dimensional array. The memory location of the array is obtained by the VARPTR function and passed to Quikplot via the USR call.

One array dimension is used to specify the picture number P (identifying a set of lines to be displayed in one call to Quikplot). The other dimension holds the specification of the set of lines.

The endpoints of lines are identified in the usual TRS-80 manner, with X ranging from 0 to 127 and Y ranging from 0 to 47. Point (0,0) is at the upper left corner of the display screen. A subroutine (line 2000) is provided to format and transfer the list of end points in the array; the source of the endpoint values can be DATA statements, runtime computations, or interactive input. The demonstration program uses runtime computations.

The array setup routine automatically counts the number of lines to be drawn; this value is entered by the routine in Z(O,P). The size of array Z determines the number of lines that can be drawn in a single call to the plotting routine. Two array elements are needed per line.

```
310 REM AS STRAIGHT AS POSSIBLE.
320 REM
330 REM THIS PROGRAM USES TRS-80 BASIC'S "SET" FUNCTION
340 REM TO TURN ON POINTS ON THE CRT. THE POINTS ARE
350 REM PLOTTED AND SET BY ONE OF TWO SIMILAR ROUTINES.
360 REM THE ROUTINE USED IS SELECTED BASED ON WHETHER
370 REM THERE IS A GREATER DIFFERENCE IN THE X DIRECTION
380 REM OR THE Y DIRECTION.
390 REM
400 REM CLEAR THE CRT, DECLARE ALL VARIABLES AS INTEGER
410 REM AND SET LIMITING VALUES FOR X AND Y COORDINATES.
420 REM
430 CLS
440 DEFINT A-Z
450 LX=0
460 HX=127
470 LY=0
480 HY=47
490 REM GET END POINT INPUT INTERACTIVELY, TEST FOR LEGAL
500 REM VALUES, COMPUTE DIFFERENCES IF THEY ARE O.K.
510 REM
520 INPUT "ENTER X1, Y1, X2, Y2"; X1,Y1,X2,Y2
530 IF LX<=X1 AND X1<=HX AND LX<=X2 AND X2<=HX THEN 560
540 PRINT "X VALUE(S) OUT-OF-BOUNDS"
550 GOTO 520
560 IF LY<=Y1 AND Y1<=HY AND LY<=Y2 AND Y2<=HY THEN 590
570 PRINT "Y VALUE(S) OUT-OF-BOUNDS"
580 GOTO 520
590 DX = X2 - X1
600 DY = Y2 - Y1
610 IX = 1
620 IF DX < 0 THEN IX = -1: DX = -DX
630 IY = 1
640 IF DY < 0 THEN IY = -1: DY = -DY
650 REM
660 REM BRANCH TO PROPER PLOTTING ROUTINE:
670 REM
680 IF DY > DX THEN 920
690 REM FIRST ROUTINE IS USED WHEN DISTANCE BETWEEN POINTS
700 REM THE SAME IN BOTH DIRECTIONS, OR GREATER IN THE X
710 REM DIRECTION.
720 REM
730 EI = 2 * DY
740 ED = EI - 2 * DX
750 E = -DX + EI
760 FOR I = 1 TO DX
770 SET(X1,Y1)
780 X1 = X1 + IX
790 IF E<0 THEN 850
800 Y1 = Y1 + IY
810 E = E + ED
820 NEXT
830 SET(X1,Y1)
840 GOTO 520
850 E = E + EI
860 NEXT
870 SET(X1,Y1)
880 GOTO 520
890 REM
900 REM SECOND ROUTINE IS USED WHEN DIFFERENCE IN THE Y
910 REM DIRECTION IS GREATER.
920 EI = 2 * DX
930 ED = EI - 2 * DY
940 E = -DY + EI
950 FOR I = 1 TO DY
960 SET(X1,Y1)
970 Y1 = Y1 + IY
980 IF E<0 THEN 1040
990 X1 = X1 + IX
1000 E = E + ED
1010 NEXT
1020 SET(X1,Y1)
1030 GOTO 520
1040 E = E + EI
1050 NEXT
1060 GOTO 520
1070 REM
1080 REM END OF PROGRAM
```

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Line Drawing, continued...

Fastdraw-80 sets up Z with dimensions 300 by 10, so it can hold up to 11 pictures, each with up to 150 lines. You can, of course, change the dimensions of Z or even use a different array name. Don't forget that the variable used for the array name must be defined as integer by a DEFINT statement.

True animation effects are easy to achieve. Simply keep the number of lines in each set fairly small, and call the Quikplot routine inside a loop (using P as the loop variable).

You can also generate a set of picture lines more than once during a program run. Just set Z(O,P) to 0 before calling GOSUB 2000 for the first line of each new picture. Otherwise, the new lines will simply be added to the existing set. The mainline routine in Listing 3 will create and flash an endless series of random designs on your display screen.

To plot a point, simply set the end coordinates equal to the beginning coordinates. Frederick has created some impressive "warp drive" animation effects using arrays of point data.

How fast is Quikplot? We ran several timing tests for lines up to the maximum length of 128 pixels. We found that for relatively short lines (10 to 20 pixels) Quikplot calculates and plots about 50 lines per second. In a worst case example, you can "white out" the entire display screen with 48 lines of 128 pixels each in about three seconds. In comparison with using a Basic routine to SET or RESET points, Quikplot is 10 to 20 times faster.

Notes

- If you have TRSDOS and a disk drive you may wish to save the completed routine by use of the command DUMP <your file name> (START=0C00,END=0C300). Then you can reload the executable code with the Disk Basic command CMD "L", "<your file name>/CMD."
- If your TRS-80 has 48K you can usually omit the setting of MEMORY SIZE when running Quikdraw-80. This is due to the location of the Quikplot routine in the "no man's land" between the bottom of variable storage and the top of string space. You may find you can do the same with your application if string assignments are minimal. □

Listing 2.

```
0 '   ****************************************
      *          F A S T D R A W - 8 0       *
      *  By Fred Wagner, 11920 Oatfield Ct., *
      *         Portland, Or., 97229.        *
1 '   ****************************************
  This program sets up a machine language
  routine that draws and erases lines from
  a user-created list.

  SET/RESET Routine Adapted From TRS-80
  ASSEMBLY-LANGUAGE PROGRAMING By Willam
  Barden, Jr.
2 REM
  Line Drawing Routine Adapted To Z-80 From
  a DDA algoritm by J.E. Bresenham (see page
  26 of PRINCIPLES OF INTERACTIVE COMPUTER
  GRAPHICS by W. Newman and R. Sproull),
  which generates accurate, even lines.
3 REM
  This program requires 32 or 48K RAM and
  DISK- or cassette BASIC. On start-up,
  respond to MEMORY SIZE with 49000.
4 REM
  GOSUB 1000 pokes FASTDRAW routine into memory.
  A=USR(VARPTR(Z(0,P))) will then cause my routine to
  draw the lines specified by the integer array Z,
  P being the number of the picture and Z(0,P) being
  the number of lines to be drawn.
5 REM
  To create a list of lines that my routine can use,
  put the coordinates of the line in X1,Y1 and X2,Y2,
  then GOSUB 2000. Repeat this for all the lines.
  To make another picture, add 1 to P and repeat.
6 REM
  This routine draws at a rate of about 50 average-
  lenth lines per second and is well suited for
  animation (it ain't no ATARI when it comes to speed,
  but it's better than nothing) or quick drawings of
  complex displays.
7 REM
  My routine checks all endpoints and will not draw
  lines that go off the screen. To the best of my
```

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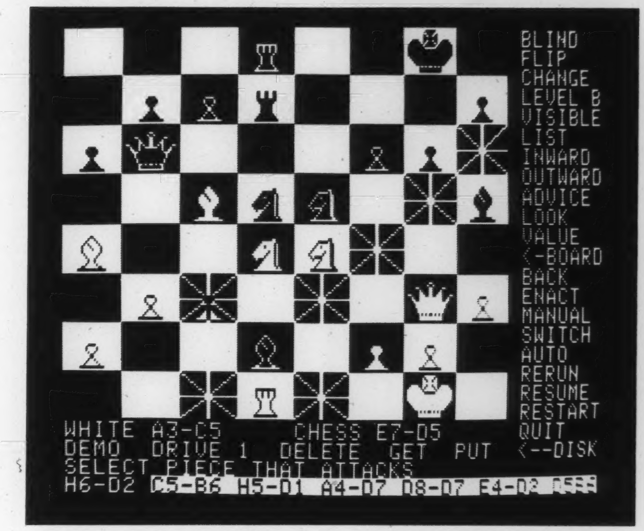
BLIND
FLIP
CHANGE
LEVEL 8
VISIBLE
LIST
INWARD
OUTWARD
ADVICE
LOOK
VALUE
<-BOARD
BACK
ENACT
MANUAL
SWITCH
AUTO
RERUN
RESUME
RESTART
QUIT
<--DISK

```
WHITE A3-C5        CHESS E7-D5
DEMO   DRIVE 1  DELETE   GET   PUT
SELECT PIECE THAT ATTACKS
H6-D2 C5-B6 H5-D1 A4-D7 D8-D7 E4-D2
```

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- Return to board or switch to command menu
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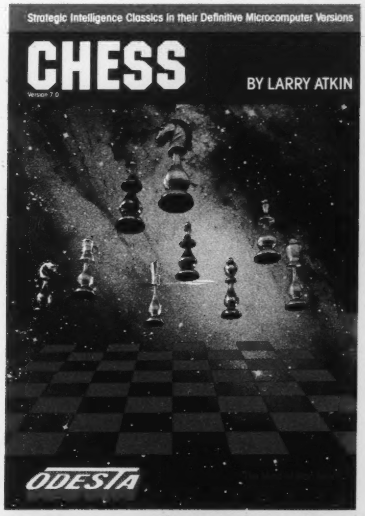
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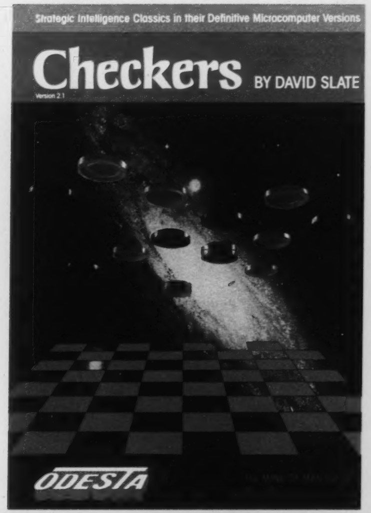
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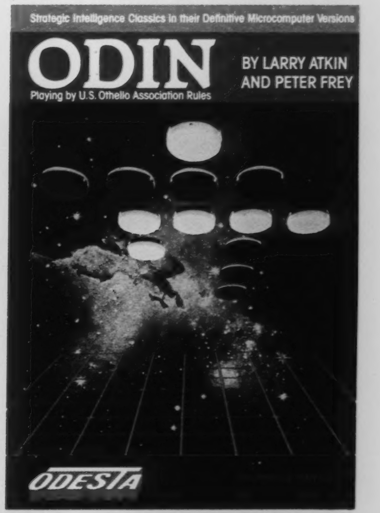
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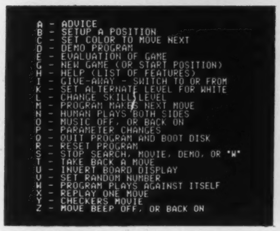
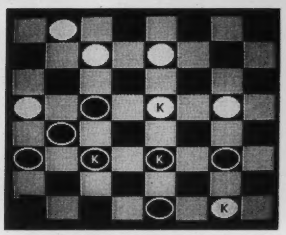
BY LARRY ATKIN AND PETER FREY
ODESTA

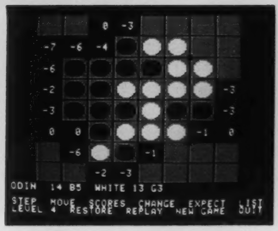


```
A - ADVICE
B - SETUP A POSITION
C - SET COLOR TO MOVE NEXT
D - DEMO PROGRAM
E - EVALUATION OF GAME
G - NEW GAME (OR START POSITION)
H - HELP (LIST OF FEATURES)
I - GIVE-AWAY - SWITCH TO OR FROM
K - SET ALTERNATE LEVEL FOR WHITE
L - CHANGE SKILL LEVEL
M - PROGRAM MAKES NEXT MOVE
N - HUMAN PLAYS BOTH SIDES
O - MUSIC OFF, OR BACK ON
P - PARAMETER CHANGES
Q - QUIT PROGRAM AND BOOT DISK
R - RESET PROGRAM
S - STOP SEARCH, MOVIE, DEMO, OR "W"
T - TAKE BACK A MOVE
U - INVERT BOARD DISPLAY
V - SET RANDOM NUMBER
W - PROGRAM PLAYS AGAINST ITSELF
X - REPLAY ONE MOVE
Y - CHECKERS MOVIE
Z - MOVE BEEP OFF, OR BACK ON
```

Checkers' features

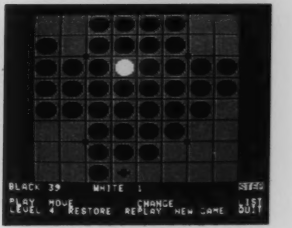


Black to move and win
(From Checkers documentation)


0
-3
-7
-6
-4
-6
-2
-3
-3
-3
0
0
-1
0
-6
-1
-2
-3
STEP
LEVEL 4
MOVE
RESTORE
SCORES
REPLAY
CHANGE
NEW GAME
EXPECT
LIST
QUIT

```
ODIN  14 B5  WHITE 13 G3
```

"Scores" feature in Odin


STEP
PLAY
LEVEL 4
MOVE
RESTORE
CHANGE
REPLAY
NEW GAME
LIST
QUIT

```
BLACK 39     WHITE  1
```

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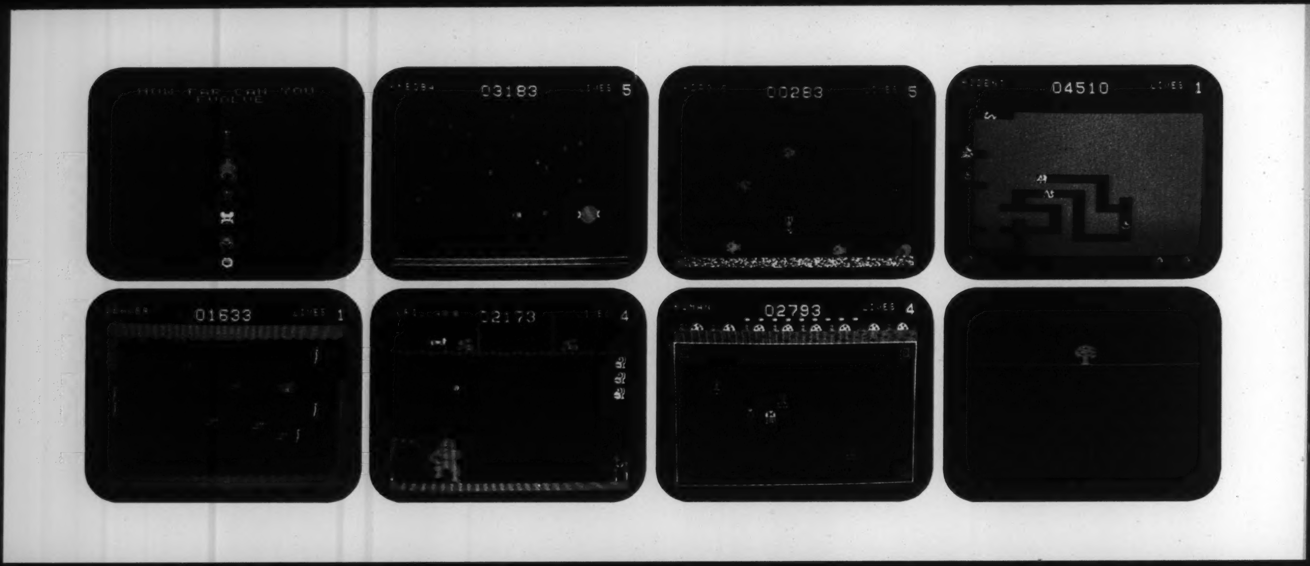

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Line Drawing, continued...

```
   knowledge, no values you can pass to it (provided
   the routine was typed in corectly) will cause it
   to 'bomb out'.
 8 REM
   How complex can a picture drawn be? Up to 65,536
   lines, although even 48K RAM could not hold an
   array of that size and the routine would loop
   through all of memory several times before
   stopping, minutes later.
 9 REM
   FASTDRAW is initalized to DRAW (SET)   nes.
   To erase (RESET) lines instead, POKE -16383,134.
   To go back to drawing lines, POKE -16383,198.
   (It's not a typo, locations obove 32767 must
   be decremented by 65,536 for POKE.)
 10 REM**************************************************
   Lines 20 and 30 set up data
   (If you have a disk system you can save
   the routine by doing a CMD"S" and entering
   DUMP LINEDRAW (START=0C000,END=0C300,TRA=0C000)
 11 REM
   To reload from DISK BASIC do a CMD"L","LINEDRAW/CMD")

 20 CLS
   :CLEAR 100
   :DEFINT A-Z
   :DIM Z(300,10)'Array Z will hold up to 11 pictures of
                150 lines each.
 30 REM Poke routine into memory:

 35 GOSUB 1000
 40 REM**************************************************
  Lines 50 through 90 are a demonstration
     of my routine.
 41 REM (replace with your own program)

 46 CLS:PRINT"CREATING DATA FOR ANIMATION ROUTINE"
 47 PRINT"
   PICTURE 0 IS A CONVERGING, TWO-WAY SCREEN FILL"
 50 P=0
   :FOR I=0 TO 23
   :X1=0
   :X2=127
   :Y1=I
   :Y2=I
   :GOSUB 2000
   :Y1=47-I
   :Y2=Y1
   :GOSUB 2000
   :NEXT I
 59 PRINT"
   PICTURE 1 DRAWS AN EIGHT-BLADED ROTATING CIRCLE FILL

   (WE WILL DISPLAY THESE ALTERNATELY IN WHITE-OUT AND
   BLACK-OUT)

   To stop program while it is drawing you need to hold
   <BREAK> down until BASIC scans the keyboard.
 60 P=1
   :FOR I!=0 TO 0.78539 STEP 0.08
   :X1=63
   :Y1=23
   :FOR N!=0 TO 6.2831 STEP 0.78539
   :X2=63+SIN(I!+N!)*40
   :Y2=23+COS(I!+N!)*20
   :GOSUB 2000
   :NEXT N!,I!
70 POKE -16383,198   'Draw next set of lines
80 A=USR(VARPTR(Z(0,1)))
  :A=USR(VARPTR(Z(0,0)))
  :POKE -16383,134  'Now erase
90 A=USR(VARPTR(Z(0,1)))
  :A=USR(VARPTR(Z(0,0)))
  :GOTO 70
990 REM**************************************************
 Lines 1000 to 1090 POKE routine into memory.

1000 A=10
```

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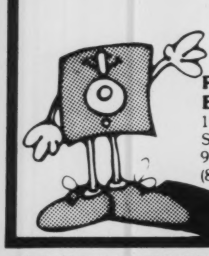

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CIRCLE 228 ON READER SERVICE CARD

Line Drawing, continued...

```
1005 CLS
    :PRINT"CONVERTING HEX CODE TO DECIMAL AND
POKING INTO MEMORY
"
1010 AS$(0)="3EC618063E8618023E463246C07A06FF04D603F210C0C603CB"
1011 AS$(0)=AS$(0)+"274F68260006062910FD1600CB3B30010C1911003C1"
1012 AS$(0)=AS$(0)+"9CB21CB21CB213A46C0813246C07EE68020023680CB"
1013 AS$(0)=AS$(0)+"FECB00C9"
1020 AS$(1)="2AFCC3ED5BFEC3443E2F90F8F23E2F90F8453E7F90F8433E7F9"
1021 AS$(1)=AS$(1)+"0F8D5E5CD00C0D1D5CD00C0D1E17C42903250C37D43"
1022 AS$(1)=AS$(1)+"903251C33EFF3252C33253C33A51C3E680280D3A51C"
1023 AS$(1)=AS$(1)+"3ED443251C33E013252C33A50C3E680280D3A50C3ED"
1024 AS$(1)=AS$(1)+"443250C33E013253C33A51C3FE0020053A50C3FE00C"
1025 AS$(1)=AS$(1)+"83A51C3473A50C390"
1030 AS$(2)="E68028633A51C3CB2F473A50C3903254C33A51C347EB3A50C30"
1031 AS$(2)=AS$(2)+"0003250C33A51C300003251C3C5D5CD00C0D13A54C3"
1032 AS$(2)=AS$(2)+"E68020203A51C3473A50C3"
1040 AS$(3)="90F53A54C347F1803254C33A52C3835F3A53C38257C110D4C93"
1041 AS$(3)=AS$(3)+"A50C3473A54C3803254C33A52C3835FC110C0C93A50"
1042 AS$(3)=AS$(3)+"C3473A51C3903254C33A50C347EB3A50C3CB273250C3"
1043 AS$(3)=AS$(3)+"3A51C3CB273251C3C5D5CD00C0D13A54C3E68020203"
1044 AS$(3)=AS$(3)+"A50C3473A51C390F53A54C347F1803254C33A53C382"
1045 AS$(3)=AS$(3)+"573A52C3835FC110D4C93A"
1050 AS$(4)="51C3473A54C3803254C33A53C38257C110C0C9C9C9CD7F0A462"
1051 AS$(4)=AS$(4)+"34E23C55E235623E5D5E5D11A6F131A67D1CDB0C1E1"
1052 AS$(4)=AS$(4)+"2323C110E879FE00C80D18E1C34FC0"
1060 N=-16384
    :FOR H=0 TO 4
    :AT$=AS$(H)
    :GOSUB 1070
    :NEXT H
    :GOTO 1080
1070 FOR I=1 TO LEN(AT$) STEP2
    :O$=MID$(AT$,I,2)
    :GOSUB1075
    :PRINT O$;
    :POKE N,Z
    :N=N+1
    :NEXT I
    :RETURN
1075 N$=LEFT$(O$,1)
    :GOSUB 1076
    :Z=X*16
    :N$=RIGHT$(O$,1)
    :GOSUB 1076
    :Z=Z+X
    :RETURN
1076 X=ASC(N$)-48
    :IF X>9 THEN X=X-7
    :RETURN
     ELSE
     RETURN
1080 DEFUSR=-15990
    :REM
    For non-disk BASIC type in line 1080 to look like this:
     POKE 16526,138
    :POKE 16527,194
1090 RETURN
1100 REM**************************************************
 Line 2000 takes the line from (X1,Y1) to (X2,Y2)
 and adds it to picture P

2000 Z(Z(0,P)*2+1,P)=X2+INT(Y2)*256
    :Z(Z(0,P)*2+2,P)=X1+INT(Y1)*256
    :Z(0,P)=Z(0,P)+1
    :RETURN
```

Listing 3.

```
41 Z(0,0)=0  :  P=0  :  X2=RND(127)  :  Y2=RND(47)
42 FOR I=1 TO RND(20)
43 X1=X2  :  X2=RND(127)  :  Y1=Y2  :  Y2=RND(47)
44 GOSUB 2000
45 NEXT
46 CLS
47 A=USR(VARPTR(Z(0,P)))
48 GOTO 41
2000 RETURN
```

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CIRCLE 126 ON READER SERVICE CARD

Lo-Res Fantasy Art

Alan Foxx and Todd Holforty

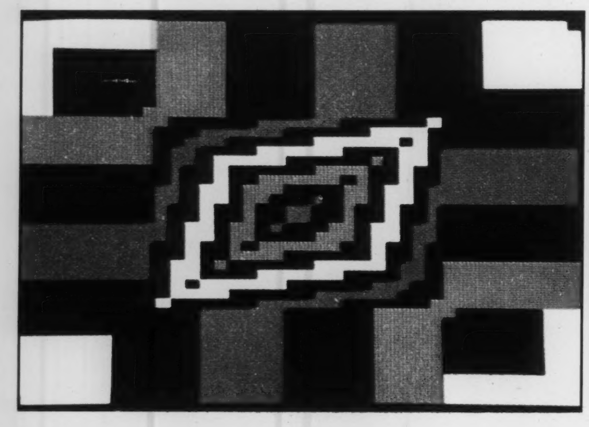
If I told you that you could quickly and simply create interesting and attractively colorful abstract patterns in Apple lo-res graphics and have fun doing so, you might have a hard time believing me. You probably feel that lo-res doesn't pack the necessary punch to do anything really exciting. Well that is just not so—and I will prove it to you.

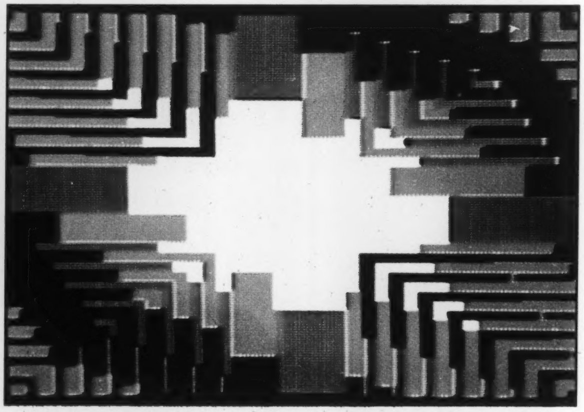
The demonstration programs that follow show how nested FOR loops in lo-res graphics can be harnessed to create appealing designs. I will assume you already know at least a little bit about lo-res graphics on the Apple. In most of the demos the colors are controlled by DATA statements. The others are controlled by an equation.

If you want to experiment with your own designs, try altering DATA statements in the program lines that include them. Use numbers between 0 and 15. They will change the design to represent your choice of new colors. Make sure

Alan Foxx, 28090 Tavistock Trail, Southfield, MI.

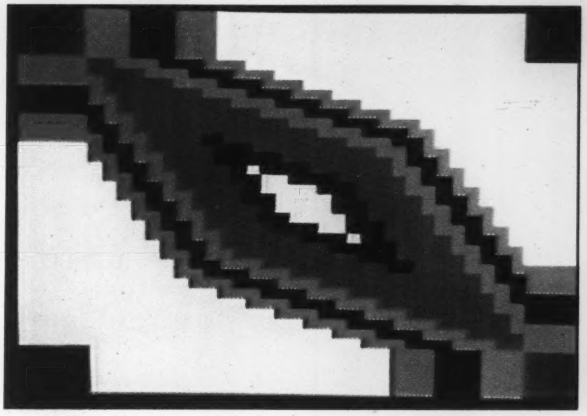
Todd Holforty, 2783 Hillendale, Rochester, MI 48063.



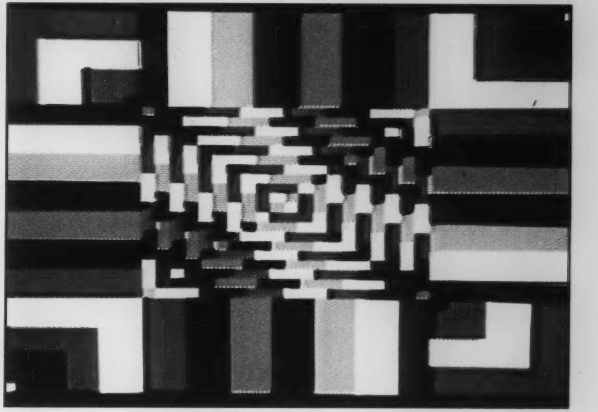


```
10   REM    LO-RES FANTASY #1
20   GR
30   FOR I = 20 TO 30
40   FOR J = 0 TO 39
50 L = L + 0.8
60   IF L > 4 THEN  READ C:L = 0: IF
      C =  - 1 THEN  RESTORE : READC
70   COLOR= C
80   VLIN I,I + 9 AT J
82   HLIN I,I + 9 AT J
85   VLIN 39 - I,30 - I AT 39 - J
87   HLIN 39 - I,30 - I AT 39 - J
90   NEXT : NEXT
100   DATA  15,0,2,0,6,0,-1
```

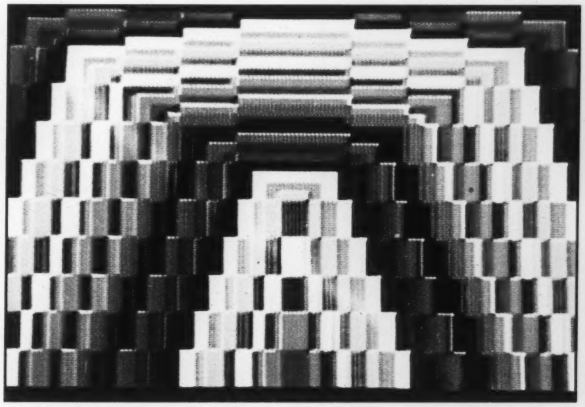
```
10   REM    LO-RES FANTASY #2
20   GR
30   FOR I = 0 TO 19
40   FOR J = 0 TO 39
50 L = L + 0.5
60   IF L > 4 THEN  READ C:L = 0: IF
      C =  - 1 THEN  RESTORE : READC
70   COLOR= C
80   VLIN I,I + 4 AT J
82   HLIN I,I + 4 AT J
85   VLIN 39 - I,35 - I AT 39 - J
87   HLIN 39 - I,35 - I AT 39 - J
90   NEXT : NEXT
100   DATA  9,9,0,9,15,15,1,5,0,-1
```



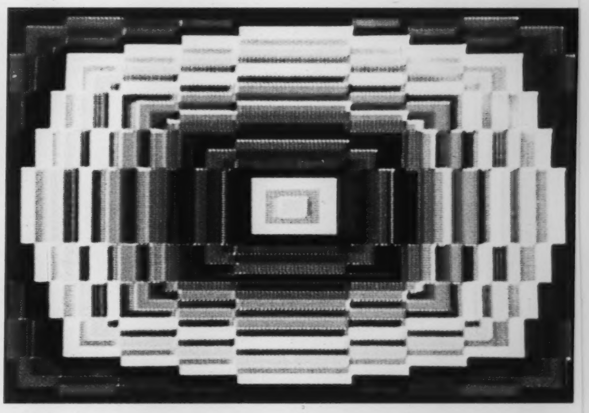
```
10  REM  LO-RES FANTASY #3
20  GR
30  FOR I = 20 TO 35
40  FOR J = 0 TO 39
50 L = L + 1.8
60  IF L > 4 THEN  READ C:L = 0: IF
     C =  - 1 THEN  RESTORE : READ C
70  COLOR= C
80  VLIN I,I + 4 AT J
82  HLIN I,I + 4 AT J
85  VLIN 39 - I,35 - I AT 39 - J
87  HLIN 39 - I,35 - I AT 39 - J
90  NEXT : NEXT
100  DATA  9,8,8,8,0,15,15,15,15,
     15,15,15,9,0,-1
```



```
10  REM   LO-RES FANTASY #4
20  GR
30  FOR I = 20 TO 30
40  FOR J = 0 TO 39
50 L = L + 2
60  IF L > 4 THEN  READ C:L = 0: IF
     C =  - 1 THEN  RESTORE : READ C
70  COLOR= C
80  VLIN I,I + 9 AT J
82  HLIN I,I + 9 AT J
85  VLIN 39 - I,30 - I AT 39 - J
87  HLIN 39 - I,30 - I AT 39 - J
90  NEXT : NEXT
100  DATA  15,8,0,9,0,13,15,0,1,-1
```



```
10  REM LO-RES FANTASY #5
20  GR
30  FOR I = 0 TO 39: FOR J = 0 TO
     39: COLOR= I + J / 4 + 4: PLOT
     I,39 - J: PLOT J,39 - I: PLOT
     39 - J,39 - I: PLOT 39 - I,3
     9 - J: NEXT : NEXT
```



```
10  REM LO-RES FANTASY #6
30  GR : FOR I = 0 TO 39: FOR J =
     0 TO 39: COLOR= I + J / 4 +
     4: PLOT I,39 - J: PLOT J,39 -
     I: PLOT 39 - J,39 - I: PLOT
     39 - I,39 - J: PLOT 39 - I,J
     : PLOT 39 - J,I: PLOT I,J: PLOT
     J,I: NEXT : NEXT
```

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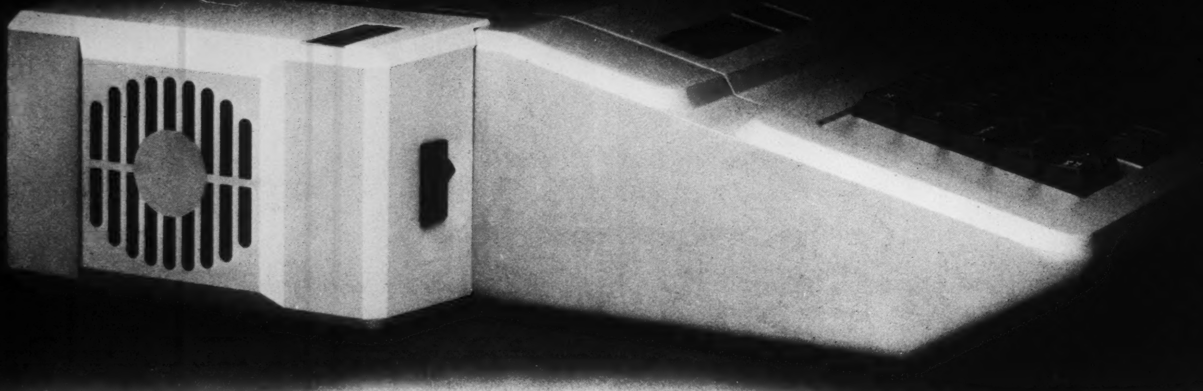

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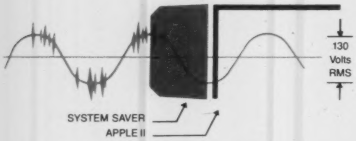

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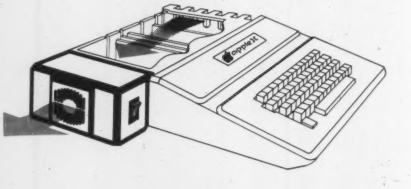

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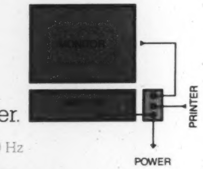

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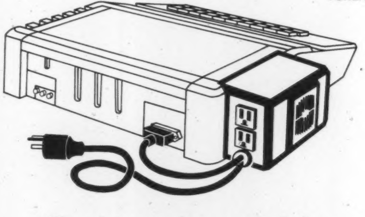

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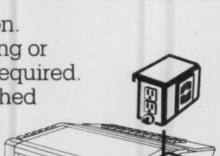

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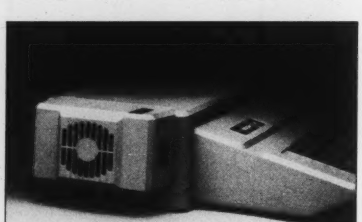

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CIRCLE 203 ON READER SERVICE CARD

that the DATA statements always end with a negative number. As soon as the program encounters a negative, it will replace the pointer and start reading colors from the beginning of the list again.

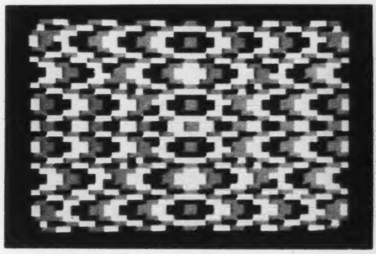
If you use the same number repeatedly in a DATA statement, that color will appear more often. In this way you can create designs with a dominant color. Let's say you want your design to use red as its dominant color. Your DATA statement could read as follows:

```
100 DATA 1,1,1,1,1,0,0,15,
0,15,-1
```

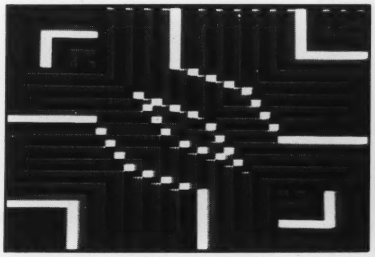
This creates a design that uses white, black, and red, with red as the dominant color. To refresh your memory concerning the numbering of lo-res colors, run the color demo on a DOS master disk. Another effect you may want to try is a checkerboard design. To attempt this, you must alternate colors in the DATA statement. As an example, here is the way to create an orange and yellow checkerboard with a central design:

```
100 DATA 9,13,9,13,9,13,9,
13,9,13,9,13,0,0,15,15,
15,-1
```

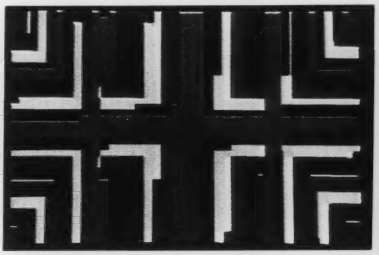
You may wish to experiment with the numbers in the FOR loops as well. When editing these programs, it is fun to predict what changes a modification will bring about, then run it to see if you were right. Of course, you can never really appreciate a loop-generated design until you see its result on the screen. □



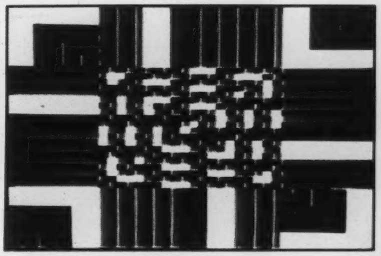
```
5  REM LO-RES FANTASY #7
10  GR : READ C
15  FOR J = 20 TO 39
20  FOR I = 0 TO J
30 L = L + 1
35  IF L > 1 THEN  READ C:L = 0: IF
     C =  - 1 THEN  RESTORE : READ C
38  COLOR= C
40  PLOT I,J: PLOT 39 - I,39 - J
42  PLOT 39 - I,J: PLOT I,39 - J
50  NEXT I
60  NEXT J
70  DATA  6,2,0,-1
```



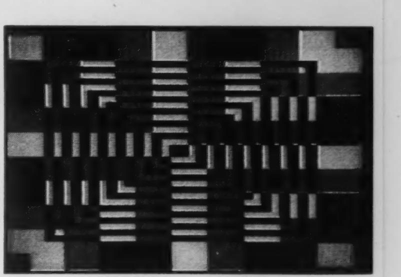
```
5  REM LO-RES FANTASY #8
20  GR
30  FOR I = 20 TO 30
40  FOR J = 0 TO 39
60  READ C: IF C =  - 1 THEN  RESTORE
     : READ C
70  COLOR= C
80  VLIN I,I + 9 AT J
82  HLIN I,I + 9 AT J
85  VLIN 39 - I,30 - I AT 39 - J
87  HLIN 39 - I,30 - I AT 39 - J
90  NEXT : NEXT
100  DATA  0,15,9,8,9,8,9,8,9,8,9
     ,8,9,8,-1
```



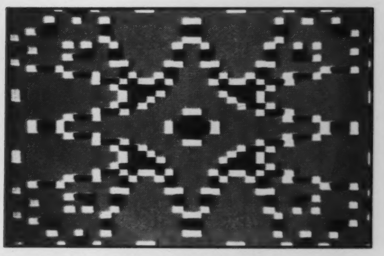
```
5  REM LO-RES FANTASY #9
10  GR : READ C
15  FOR J = 0 TO 19
20  FOR I = 0 TO 39
30 L = L + 0.015
35  IF L > 1 THEN  READ C:L = 0: IF
     C =  - 1 THEN  RESTORE : READ C
38  COLOR= C
40  PLOT J,I: PLOT 39 - J,39 - I
42  PLOT I,J: PLOT 39 - I,39 - J
50  PLOT J / 2,I: PLOT 39 - J / 2
     ,39 - I
52  PLOT I / 2,J: PLOT 39 - I / 2
     ,39 - J
60  NEXT : NEXT
70  DATA  8,9,0,1,13,-1
```



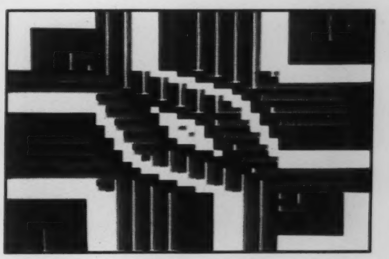
```
5  REM LO-RES FANTASY #10
20  GR
30  FOR I = 20 TO 30
40  FOR J = 0 TO 39
60  READ C: IF C =  - 1 THEN  RESTORE
     : READ C
70  COLOR= C
80  VLIN I,I + 9 AT J
82  HLIN I,I + 9 AT J
85  VLIN 39 - I,30 - I AT 39 - J
87  HLIN 39 - I,30 - I AT 39 - J
90  NEXT : NEXT
100  DATA  0,0,15,15,15,13,9,13,9
     ,13,9,13,9,13,9,-1
```



```
10  REM  LO-RES FANTASY #11
20  GR
30  FOR I = 20 TO 35
40  FOR J = 0 TO 39
50 L = L + 1
60  IF L = 4 THEN  READ C:L = 0: IF
     C =  - 1 THEN  RESTORE : READ C
70  COLOR= C
80  VLIN I,I + 4 AT J
82  HLIN I,I + 4 AT J
85  VLIN 39 - I,35 - I AT 39 - J
87  HLIN 39 - I,35 - I AT 39 - J
90  NEXT : NEXT
100  DATA  0,8,13,9,-1
```



```
5  REM  LO-RES FANTASY #12
10  GR : READ C
15  FOR J = 0 TO 19
20  FOR I = 0 TO J
35  READ C: IF C =  - 1 THEN  RESTORE
     : READ C
38  COLOR= C
40  PLOT I,J: PLOT 39 - I,39 - J
42  PLOT 39 - I,J: PLOT I,39 - J
45  PLOT J,I: PLOT 39 - J,39 - I
47  PLOT 39 - J,I: PLOT J,39 - I
50  NEXT I
60  NEXT J
70  DATA  0,15,3,3,3,3,3,3,3,3,3,
     3,3,15,0,-1
```



```
5  REM LO-RES FANTASY #13
20  GR
30  FOR I = 20 TO 30
40  FOR J = 0 TO 39
60  READ C: IF C =  - 1 THEN  RESTORE
     : READ C
70  COLOR= C
80  VLIN I,I + 9 AT J
82  HLIN I,I + 9 AT J
85  VLIN 39 - I,30 - I AT 39 - J
87  HLIN 39 - I,30 - I AT 39 - J
90  NEXT : NEXT
100  DATA  0,0,0,15,15,15,13,9,13
     ,9,13,9,13,9,-1
```

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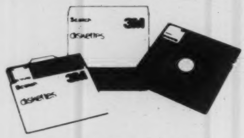

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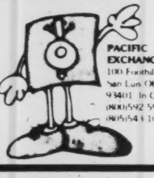

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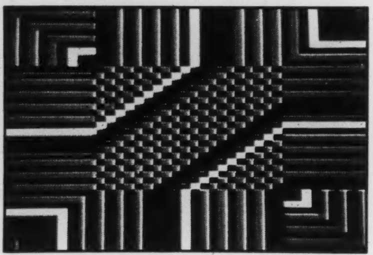
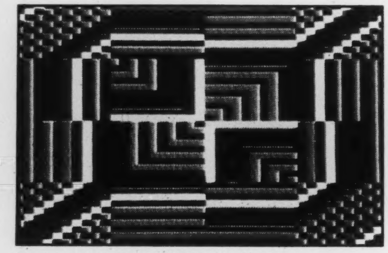
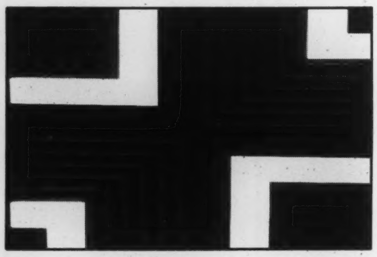


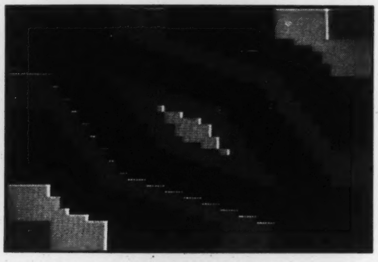
```
5  REM LO-RES FANTASY #14
20  GR
30  FOR I = 20 TO 30
40  FOR J = 0 TO 39
60  READ C: IF C =  - 1 THEN  RESTORE
   : READ C
70  COLOR= C
80  VLIN I,I + 9 AT J
82  HLIN I,I + 9 AT J
85  VLIN 39 - I,30 - I AT 39 - J
87  HLIN 39 - I,30 - I AT 39 - J
90  NEXT : NEXT
100  DATA  0,0,9,15,0,13,9,13,9,1
    3,9,13,9,-1
```



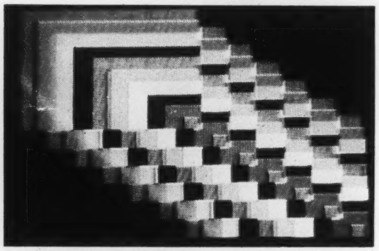
```
5  REM LO-RES FANTASY #15
20  GR
30  FOR I = 0 TO 10
40  FOR J = 0 TO 39
60  READ C: IF C =  - 1 THEN  RESTORE
   : READ C
70  COLOR= C
80  VLIN I,I + 9 AT J
82  HLIN I,I + 9 AT J
85  VLIN 39 - I,30 - I AT 39 - J
87  HLIN 39 - I,30 - I AT 39 - J
90  NEXT : NEXT
100  DATA  0,0,9,15,0,13,9,13,9,1
    3,9,13,9,-1
```



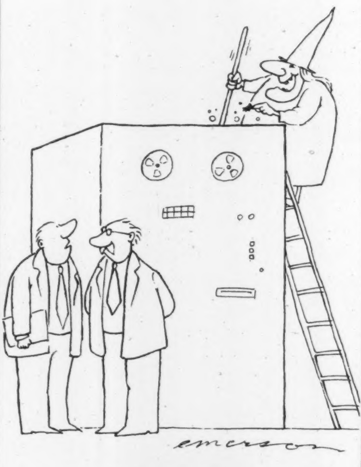
```
5  REM LO-RES FANTASY #16
20  GR
30  FOR I = 20 TO 30
40  FOR J = 0 TO 39
60  READ C: IF C =  - 1 THEN  RESTORE
   : READ C
70  COLOR= C
80  VLIN I,I + 9 AT J
82  HLIN I,I + 9 AT J
85  VLIN 39 - I,30 - I AT 39 - J
87  HLIN 39 - I,30 - I AT 39 - J
90  NEXT : NEXT
100  DATA  0,0,0,0,15,15,15,15,9,
    8,9,8,9,8,9,8,9,8,9,8,-1
```



```
10  REM  LO-RES FANTASY #17
20  GR
30  FOR I = 20 TO 35
40  FOR J = 0 TO 39
50 L = L + 0.7
60  IF L > 4 THEN  READ C:L = 0: IF
    C =  - 1 THEN  RESTORE : READ C
70  COLOR= C
80  VLIN I,I + 4 AT J
82  HLIN I,I + 4 AT J
85  VLIN 39 - I,35 - I AT 39 - J
87  HLIN 39 - I,35 - I AT 39 - J
90  NEXT : NEXT
100  DATA  8,9,13,0,8,9,0,-1
```



```
3  REM LO-RES FANTASY #18
5  GR
10  FOR J = 0 TO 19: FOR I = 0 TO
    19
15  FOR K = 0 TO 20 STEP 3
17  COLOR= I / 2 + 1
18  PLOT I + K,J + K: PLOT J + K,
    I + K
20  NEXT : NEXT
25  NEXT
```



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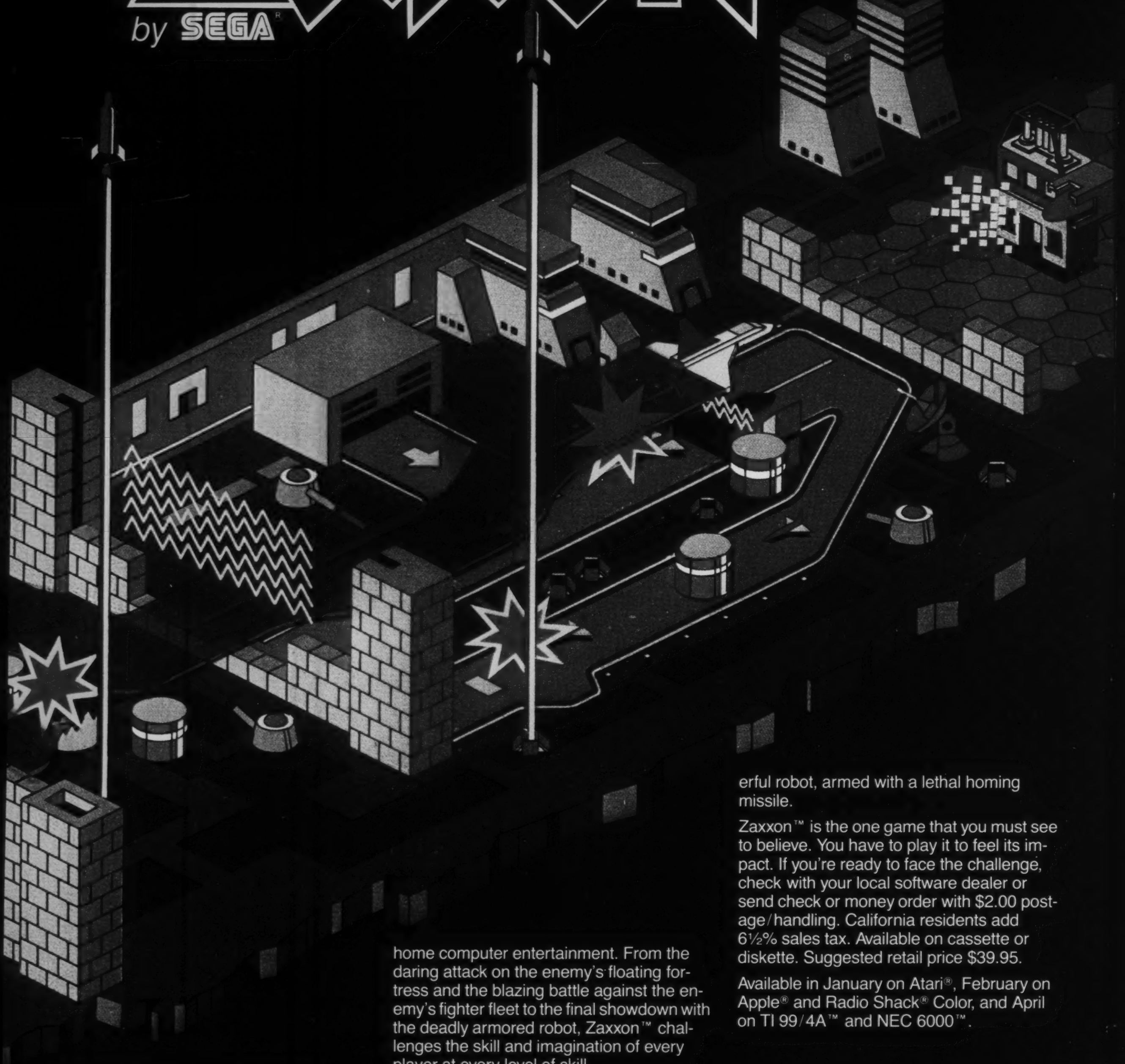

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Graphics Routines For The IBM PC

Dan Gabrielson

One picture certainly is worth a thousand words. Think of all the ways we communicate with pictures—television, movies, paintings, maps.

Well, the coming computer revolution is going to change all that. With low cost hardware and versatile software available, more and more people are going to be communicating with pictures—through computers.

Math departments across the country are already scrambling to use personal computers as electronic blackboards—tools to bridge the gap between theory and application. In fact, some branches of mathematics, it seems, were just waiting for computer graphics to be developed, so they could really take off.

Being a math and computer major, I had seen many applications in which the two fields complemented each other. So when I began shopping for a home computer, I knew it had to have graphics capabilities.

I came across the IBM PC and was very impressed. It had some powerful graphics commands like CIRCLE and PAINT, but all of them depended on absolute coordinates of 0 to 319 in the x direction and 0 to 199 in the y. These commands were just too limited for the graphing I had in mind. I decided to write my own graphics routines and call them using dummy parameters and subroutines.

Wrong again! IBM Basic allows only GOSUBs in which all variables are global, and the chances were good that I would forget which variables I had used and confuse them with program variables. Another solution would have been to write the routines in machine language, but I didn't have an assembler.

Instead, I came up with a collection of quick and dirty routines which I call Q-Graphics. Every variable used in my subroutines begins with the letter Q, so I no longer have to worry about confusing them with program variables.

The method of calling the routines is a bit primitive, but I didn't have to buy an assembler, and they don't take up much memory. All parameters are set, and then the routine is called, but more about that later.

Q-Graphics is loosely based on the Core graphics system standard used by Siggraph, the special interest group for computer graphics. Points are referenced according to a pre-defined "world coordinate system," and are then internally translated into the "screen coordinates" needed by the given machine.

Using The Program

You will have to write a program to use these commands, which start at line 1000. All of the routines are called by the Basic command GOSUB. Along the way I have included as many examples as I could, and the program listing has three mathematical functions drawn with the Q-Graphics commands.

The first command necessary is INIT. This initializes the system to one of the two color palettes available for medium resolution graphics. To start, set the parameter variable Q1 to 0 or 1, depending on the color palette desired. The Initialize routine is on line 1000 and is called by

```
10 Q1=0: GOSUB 1000                    INIT 0
```

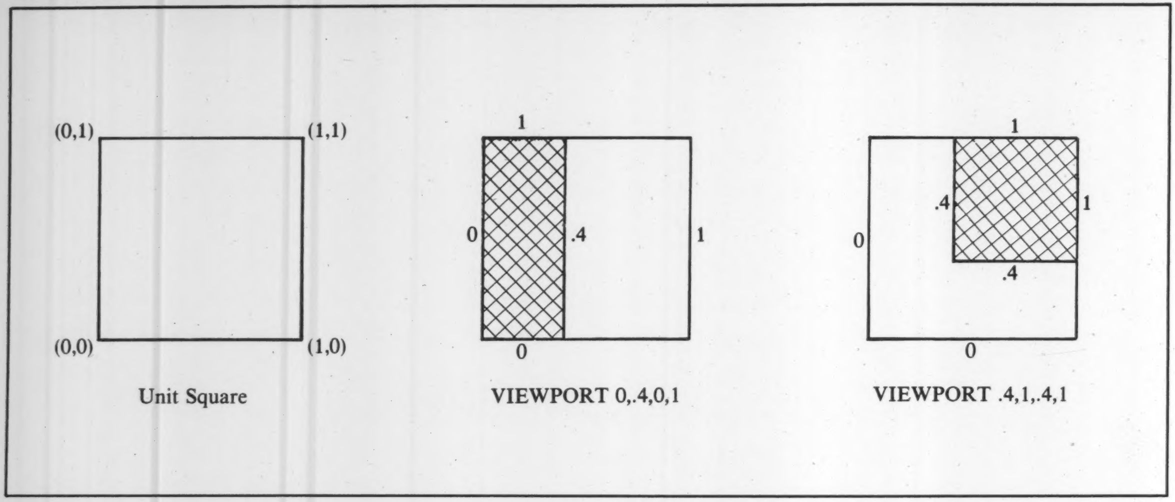
INIT sets several default conditions which will be explained later:

```
VIEWPORT 0,1,0,1
WINDOW 0,1,0,1
MOVETO 0,0
COLOR 3
CLS
```

Viewport

There will be many new terms here, so I shall try to take them slowly. First, there is a viewport. This defines the region of the screen to be used for graphics. It may be the entire screen or only a small portion of it. Let's set up the screen as a one-unit square box with the lower left corner at the origin (see Fig-

Dan M. Gabrielson, 218A Northwestern Ave., Oshkosh, WI 54901.



Unit Square

VIEWPORT 0,.4,0,1

VIEWPORT .4,1,.4,1

Figure 1.

ure 1). Then we can define any rectangular region of that square by four numbers, the left and right x values (between 0 and 1), and the bottom and top y values (also between 0 and 1).

For example, the left half of the screen could be defined as 0,.4,0,1. The maximum area would be defined as 0,1,0,1 (see Figure 1).

To set the viewport in the Q-Graphics system, you must specify each of the four parameters and then call the VIEWPORT routine located on line 1100. If this was to be line 140, we could say:

```
140 Q1=0 : Q2=.4 : Q3=0 : Q4=1 : GOSUB 1100     VIEWPORT 0,.4,0,1
```

All further graphics commands will appear only in this portion of the entire screen. The viewport may be re-defined at any time, and all following commands will then be executed in the new region.

Window

The next new term is window. This sets up a "world coordinate" system for the current viewport. If you want to graph some functions, you specify the region you want to show, and all the following commands need reference points only relative to that region. All translations between the points you choose and the corresponding points on the screen are handled by the computer.

The window is defined the same way as the viewport, but the values given to the variables are not limited to between 0 and 1. Let's say you wanted to draw the parabola $y=x^2$ and only show the region from -5 to 5 in the x direction and -1 to 10 in the y direction. A statement like

```
150 Q1=-5 : Q2=5 : Q3=-1 : Q4=10 : GOSUB 1200 WINDOW -5,5,-1,10
```

could set up those coordinates in the current viewport (see Figure 2). Now all you have to do is work with points in this rectangular region; the translations will be handled automatically.

In the above case, the x and y scales are not the same. With a bit of calculation, you could figure out what the true-to-scale parameters would be. The command SHOW will do those calculations for you. It is called exactly the same way as WINDOW, but the values you save may be altered a bit, as the graphing area is stretched or shrunk to fit the viewport with one unit in the x direction approximately equal to one unit in the y.

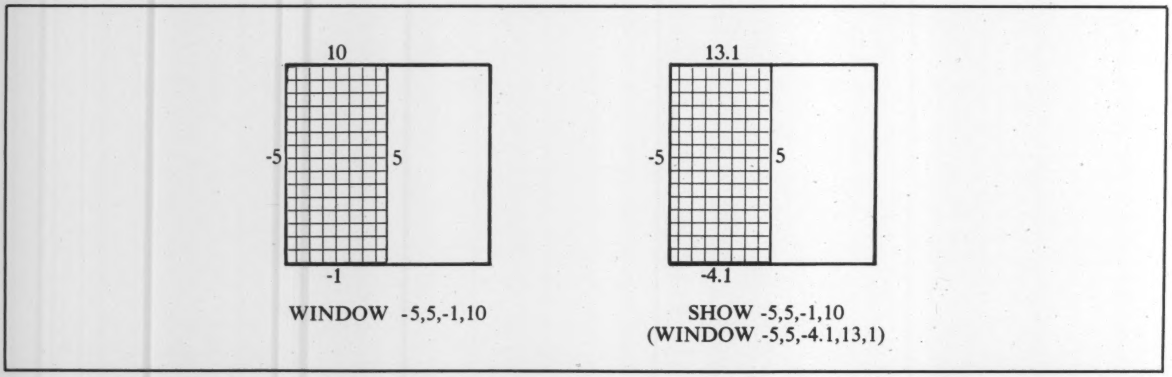
Our previous example could be written as

```
150 Q1=-5 : Q2=5 : Q3=-1 : Q4=10 : GOSUB 1300 SHOW -5,5,-1,10
```

and the Q3 and Q4 values would be changed internally to -4.1 and 13.1, to better fit the viewport (see Figure 2).

Now that the graphing area has been defined and scaled, the move and draw commands can be used. Both of these reference points in the world coordinate system and refer to an imaginary

Figure 2.



WINDOW -5,5,-1,10

SHOW -5,5,-1,10
(WINDOW -5,5,-4.1,13,1)

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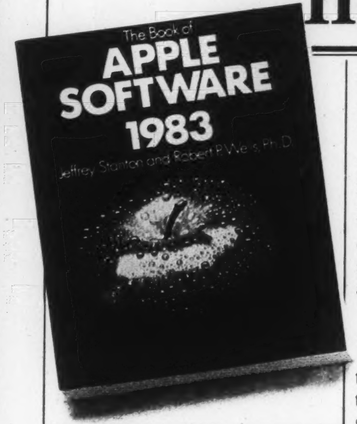

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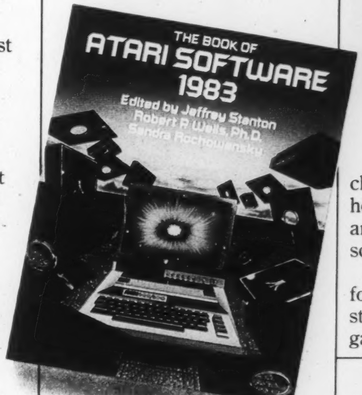

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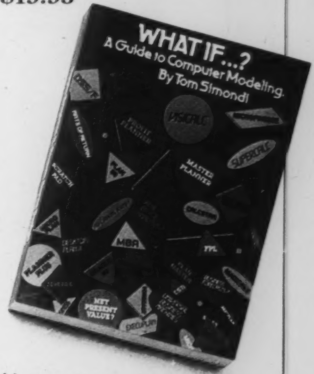

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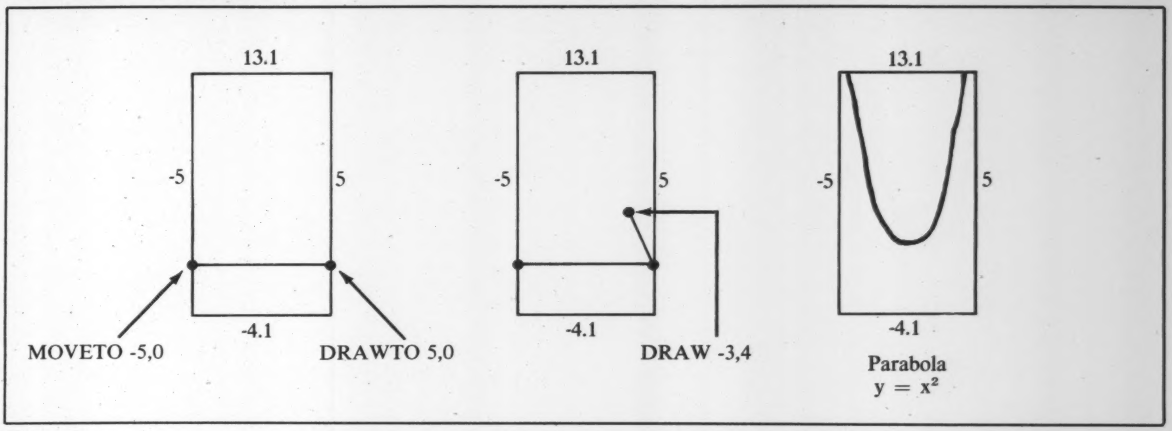


Figure 3.

pen. There are two types of move and draw commands: relative and absolute.

Absolute referencing refers to the actual points of the world system. To move the pen to the point (-5,0) without drawing any lines, we say

```
180 QX=-5 : QY=0 : GOSUB 1800                    MOVETO -5,0
```

To draw a line from the previous point to the point (5,0), we could say

```
190 QX=5 : QY=0 : GOSUB 2000                     DRAWTO 5,0
```

Notice that in the above examples, I used QX and QY instead of Q1, Q2, etc. The move and draw commands all use QX and QY to refer to x and y distances in world coordinates.

Relative referencing is similar to absolute but is based on the current position of the pen. A statement like

```
 195 QX=-3 : QY= 4 : GOSUB 1900                   DRAW -3,4
```

would draw a line from the current position of the pen to a point 3 units to the left and 4 units up (see Figure 3). The relative move command does the same thing, but doesn't leave any visible line connecting the two points.

To draw our parabola $y=x^2$ we will start at the point (-5,25) and vary x until $x=5$, drawing to each point on the parabola as we calculate it.

```
 10 Q1=0 : GOSUB 1000                          Initialize
130 DEF FNF(X)=X²                              Parabola y=x²
140 Q1=0 : Q2=.4 : Q3=0 : Q4=1 : GOSUB 1100    Viewport 0,.4,0,1
150 Q1=-5 : Q2=5 : Q3=-1 : Q4=10 : GOSUB 1300 SHOW -5,5,-1,10
170 QX=-5 : QY=FNF(QX) : GOSUB 1800            MOVETO x,x²
180 FOR QX=-5 to 5 STEP .2 :
         QY=FNF(QY) : GOSUB 2000 : NEXT        DRAWTO x,x²
```

Clipping

If a point specified is out of range of the window, the line is "clipped" to the edge of the window, but the computer acts as if it has drawn to that point. For example,

```
170 QX=0 : QY=0 : GOSUB 1800                     MOVETO 0,0
180 QX=20 : QY=6 : GOSUB 2000                    DRAWTO 20,6
190 QX=2 : QY=9 : GOSUB 2000                     DRAWTO 2,9
```

results in the line being drawn off the page and back on. Only those parts which fall within the window are shown (see Figure 4).

All lines are clipped to a "clipping region," which is similar to the window. In fact, for the default case, the clipping region is the window. This region can be defined smaller than the current window with the CLIP command, located on line 1400. CLIP has four parameters, Q1, Q2, Q3, and Q4, each of which is defined in world coordinates. Any parameters outside the window are reset to the window, and calling WINDOW automatically resets the clipping region to the window.

This region can also be reset manually to the window with the UNCLIP command. CLIP and UNCLIP are used to limit the region of the window to be used for graphing. In our continuous example, inserting the line

```
175 Q1=-3 : Q2=3 : Q3=0 : Q4=6 : GOSUB 1400    CLIP -3,3,0,6
```

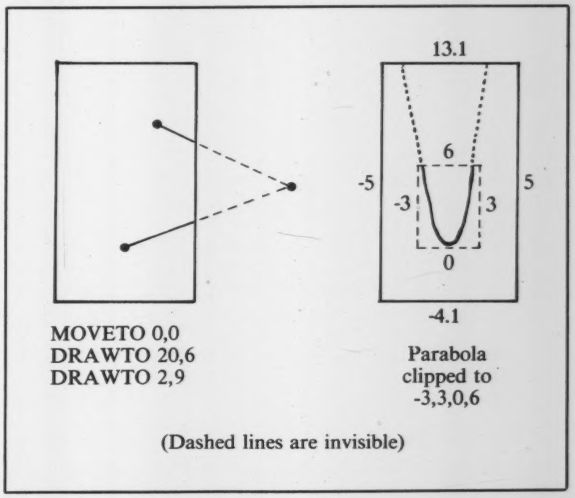
results in only part of the parabola being graphed on the screen, even though the same exact points were referenced (see Figure 4).

The UNCLIP command has no parameters, as it sets the clipping region to the current window, and is called by a statement similar to

```
190 GOSUB 1500                                   UNCLIP
```

CLIP is made up of two user-transparent subroutines, SIGCLP and SIGCOD. SIGCOD assigns a binary code from 0 to 15 revealing the position of a point with respect to the clip-

Figure 4.



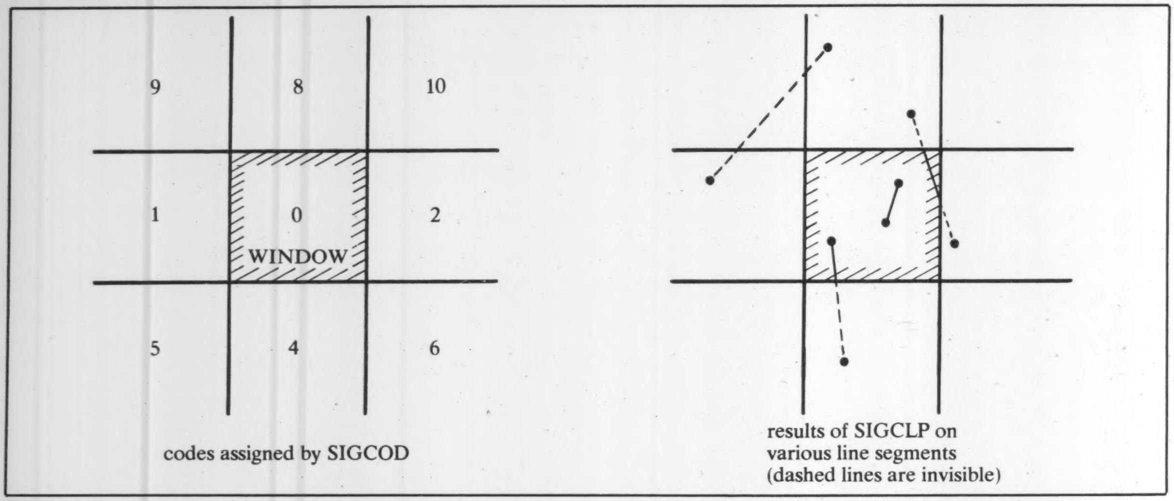


Figure 5.

ping region (see Figure 5). SIGCLP uses the results of SIGCOD on the two endpoints of a line to determine which portion, if any, of the line will be visible in the window. The actual drawing routine, SIGDRW, draws only that visible portion.

All lines are drawn in the current pen color, the default being 3. To change this color, the COLOR routine at line 1600 is used.

```
160 Q1=2 : GOSUB 1600                          COLOR 2
```

Q1 can be 0, 1, 2, or 3, and the corresponding color will be determined by the color palette specified in INIT.

Drawing Instructions

The FRAME command, at line 2100, is a series of drawing instructions that draws a box around the current clipping region. This command requires no other parameters.

```
160 GOSUB 2100                                 FRAME
```

The GRID command draws a grid of lines in the window based on four parameters. The first one, Q1, is the distance between vertical lines in the x direction. The second, Q2, is the distance between horizontal lines in the y direction. Both Q1 and Q2 must be greater than 0. The third and fourth parameters, Q3 and Q4, are the x and y world coordinates of a point to serve as a reference point. An example is

```
170 Q1=1 : Q2=1 : Q3=0 : Q4=0 : GOSUB 2200     GRID 1,1,0,0
```

to draw a grid centered on the origin, with horizontal and vertical lines in every unit.

The AXES command is similar to GRID, but only a set of x and y axes is drawn. The AXES command is located at line 2300 (see Figure 6).

The last command of the Q-Graphics system is a simple PAUSE routine. This allows the program to wait until the user presses the spacebar. I found this useful to halt the graphing process at various points along the way. It has no parameters and is located at line 2400.

I also wrote two functions which help to integrate my system with the existing IBM Basic commands. They return the screen coordinates of any world coordinate point. Remember, however, IBM Basic allows only x values in the range of 0 to 319 and y values from 0 to 199.

X=FNQX(QX) returns the x screen coordinate

Y=FNQY(QY) returns the y screen coordinate

The program listing contains a similar parabola example and a cubic equation graph. For a general cartesian function, y=f(x), the program steps are usually as follows:

1. Initialize
2. Define viewport
3. Define window
4. Frame, axes, grid, color, etc.
5. Move to first point of function, (x, f(x))
6. Vary x in a loop until the last point, drawing to calculated function points along the way.

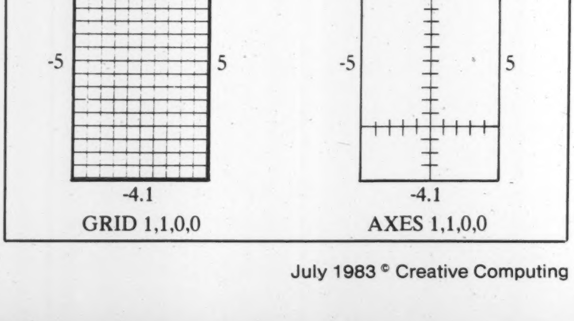
Polar Coordinates

To graph a function in polar coordinates, such as the cardiod in the listing, the steps are similar. But instead of varying the x value, vary the angle from the positive x axes. See any calculus book for a discussion of polar coordinates.

These routines provide a fairly powerful, yet inexpensive, supplement to IBM's absolute graphics. The steps needed to call each routine are a bit awkward, but you won't have to know any machine language or buy any fancy software. The programs are easily modified to allow you to experiment without too much difficulty. As long as none of the variables in your main program begins with the letter Q, you won't mess up any of the Q-Graphics bookkeeping.

I'd be interested to hear from anybody else who uses computer graphics and finds the IBM commands too limited. There are many ways to handle a graphics system; this is only one of them. ☐

Figure 6.



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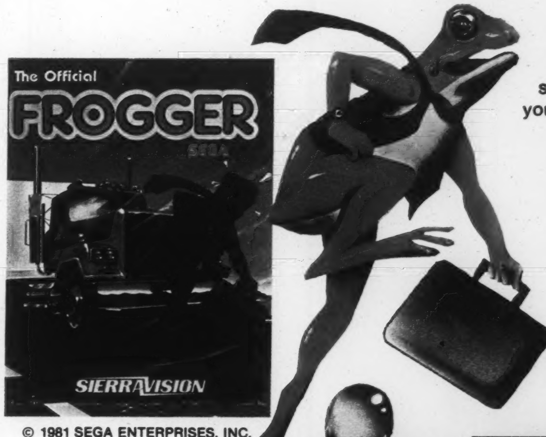

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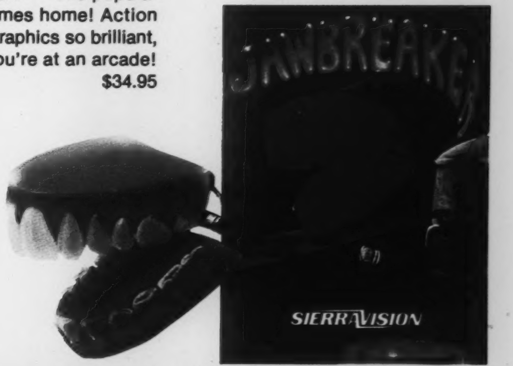

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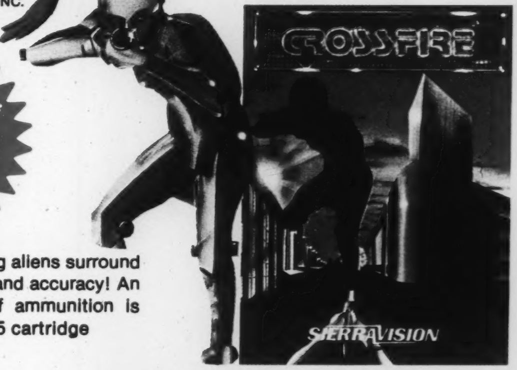

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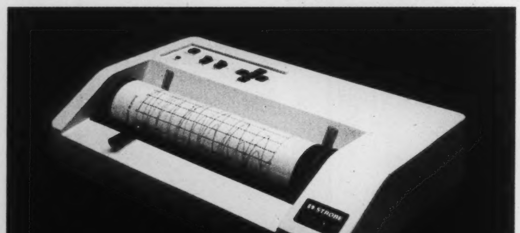

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Table 1. Q-Graphics Commands.

1000 INIT Q1	Initializes system to: VIEWPORT 0,1,0,1, WINDOW 0,1,0,1 MOVETO 0, 0 COLOR 3 CLS Q1 determines which color palette, 0 or 1
1100 VIEWPORT Q1,Q2,Q3,Q4	Defines area of screen to be used for graphics. All parameters are between 0 and 1. In order, left, right, bottom, top.
1200 WINDOW Q1,Q2,Q3,Q4	Defines an x-y scale for the current viewpoint. All parameters are in world coordinates. Left, right, bottom, top.
1300 SHOW Q1,Q2,Q3,Q4	Similar to WINDOW, but x and y will be scaled the same.
1400 CLIP Q1,Q2,Q3,Q4	Defines the region of the window to be used for graphics. All parameters are in world coordinates. Automatically set everytime WINDOW is called. Left, right, bottom, top.
1500 UNCLIP	Resets the clipping limits to the window.
1600 COLOR Q1	Changes the color of the pen. Q1=0, 1, 2, or 3.
1700 MOVE QX,QY	Relative move of QX, QY in world coördinates.
1800 MOVETO QX,QY	Absolute move to (QX,QY) in world coordinates.
1900 DRAW QX,QY	Relative draw of QX, QY in world coordinates.
2000 DRAWTO QX,QY	Absolute draw to (QX,QY) in world coordinates.
2100 FRAME	Draws a box around the current clipping region.
2200 GRID Q1,Q2,Q3,Q4	Draws a grid centered on (QX,QY) with a line every Q1 units in the x and every Q2 units in the y direction. All parameters are in world coordinates.
2300 AXES Q1,Q2,Q3,Q4	Draws a pair of axes with properties similar to grid command.
2400 PAUSE	Pauses the program until the spacebar is pressed.

Table 2. Variable References.

Q1, Q2, Q3,Q4	Command parameters.
QVXL, QWXL, QCXL, etc.	Various coordinate systems used: XL - left x XR - right x YB - bottom y YT - top y QV - viewpoint QW - window QC - clipping region
QWVXM, QWVXA	Slope and intercept of lines clipped to current clipping region
QWVYM, QWVYA	
QXSAVE, QYSAVE, QXSAVE2, QYSAVE2, WXT,QYI	Temporary variables
QXCURNT, QYCURNT	Current location of pen in world coordinates
QRATIO	Ratio of x to y distances of current viewport
QCOLOR%	Current color of pen 0, 1, 2, or 3
QCODE%	Binary description of point (QXT, QYI) with respect to clipping region.
QVX1, QVY1, QVX2, QVY2	Actual IBM Basic screen coordinates used to draw line
QGRID%	Flag used to specify GRID or AXES
Q$	Dummy string used in PAUSE routine

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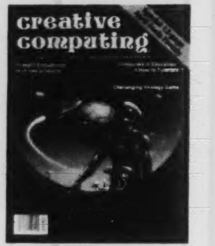

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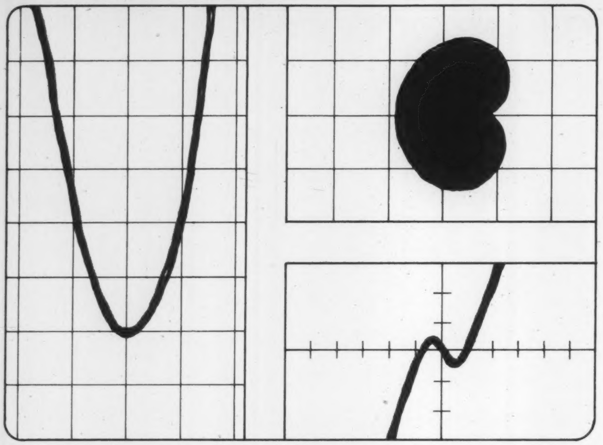

Figure 7. Output of program

```
10  Q1= 0: GOSUB 1000

20  '  cardiod
30  DEF FNF(T)=1-COS(T)
40  Q1=.5: Q2= 1: Q3=.5: Q4= 1: GOSUB 1100
50  Q1=-3: Q2= 1: Q3=-2: Q4= 2: GOSUB 1300
60  Q1= 3: GOSUB 1600: GOSUB 2100
70  Q1= 1: Q2= 1: Q3= 0: Q4= 0: GOSUB 2200: Q1= 2: GOSUB 1600
80  QX=FNF(0)*COS(0): QY=FNF(0)*SIN(0): GOSUB 1800
90  FOR A=0 TO 180 STEP 5
100    A1=6.28/180*A: R=FNF(A1): QX=R*COS(A1): QY=R*SIN(A1): GOSUB 2000: NEXT
110 X=FNQX(-.5): Y=FNQY(0): PAINT (X,Y),2,2

120 '   parabola
130 DEF FNF(X)=X^2
140 Q1= 0: Q2=.4: Q3= 0: Q4= 1: GOSUB 1100
150 Q1=-5: Q2= 5: Q3=-1: Q4=10: GOSUB 1300
160 Q1= 3: GOSUB 1600: GOSUB 2100
170 Q1= 2: Q2= 2: Q3= 0: Q4= 0: GOSUB 2200: Q1= 2: GOSUB 1600
180 QX=-5: QY=FNF(QX): GOSUB 1800
190 FOR QX=-5 TO 5 STEP .2: QY=FNF(QX): GOSUB 2000: NEXT

200 '   cubic curve
210 DEF FNF(X)=X^3-X
220 Q1=.5: Q2= 1: Q3= 0: Q4=.4: GOSUB 1100
230 Q1=-3: Q2= 3: Q3=-3: Q4= 3: GOSUB 1300
240 Q1= 3: GOSUB 1600: GOSUB 2100
250 Q1= 1: Q2= 1: Q3= 0: Q4= 0: GOSUB 2300: Q1= 2: GOSUB 1600
260 QX=-3: QY=FNF(QX): GOSUB 1800
270 FOR QX=-3 TO 3 STEP .2: QY=FNF(QX): GOSUB 2000: NEXT

280 '   all done
290 GOSUB 2400: SCREEN 0,1: WIDTH 80: END

1000 '   INIT Q1
1010 DEFSNG Q: SCREEN 1,0: KEY OFF: COLOR 0,-(Q1=1): CLS
1020 QVXL=0: QVXR=1: QVYB=0: QVYT=1
1030 QWXL=0: QWXR=1: QWYB=0: QWYT=1: GOSUB 1250
1040 QCXL=QWXL: QCXR=QWXR: QCYB=QWYB: QCYT=QWYT
1050 QXCURNT=0: QYCURNT=0: QCOLOR%=3
1060 DEF FNQX(X)=(QWVXM * X + QWVXA) * 319
1070 DEF FNQY(Y)=199 - (QWVYM * Y + QWVYA) * 199: RETURN

1100 '   VIEWPORT Q1,Q2,Q3,Q4
1110 IF Q1>=Q2 OR Q3>=Q4 OR Q1<0 OR Q1>1 OR Q2<0 OR Q2>0 OR Q3<0 OR Q3>1
        OR Q4<0 OR Q4>1 THEN PRINT "Error in VIEWPORT parameters.": END
1120 QVXL=Q1: QVXR=Q2: QVYB=Q3: QVYT=Q4: GOSUB 1250: RETURN

1200 '   WINDOW Q1,Q2,Q3,Q4
1210 IF Q1>=Q2 OR Q3>=Q4 THEN PRINT "Error in WINDOW parameters.": END
1230 QWXL=Q1: QWXR=Q2: QWYB=Q3: QWYT=Q4: GOSUB 1500

1250 '   Windowing transformation
1260 QWVXM=(QVXR-QVXL)/(QWXR-QWXL): QWVXA=QVXL-QWXL*QWVXM
1270 QWVYM=(QVYT-QVYB)/(QWYT-QWYB): QWVYA=QVYB-QWYB*QWVYM: RETURN

1300 '   SHOW Q1,Q2,Q3,Q4
1310 QRATIO=(QVXR-QVXL)/(QVYT-QVYB)*319/199
1320 QXT=(Q1-Q2)/2*(QRATIO-1)*(QRATIO>1)
1330 QYT=(Q3-Q4)/2*(1/QRATIO-1)*(1/QRATIO>1)
1340 Q1=Q1-QXT: Q2=Q2+QXT: Q3=Q3-QYT: Q4=Q4+QYT: GOTO 1200
```

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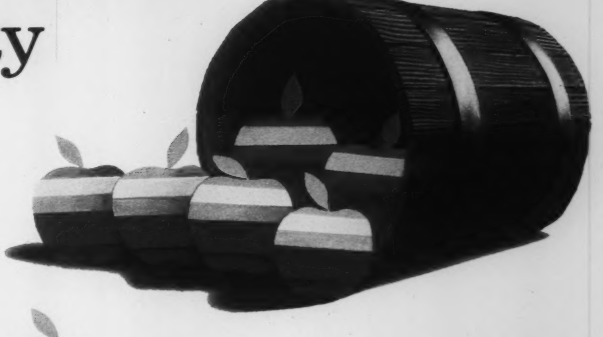

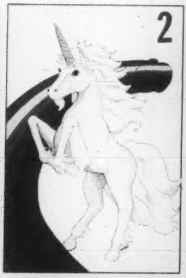

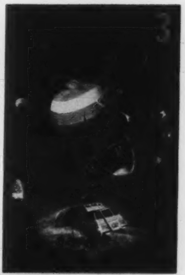

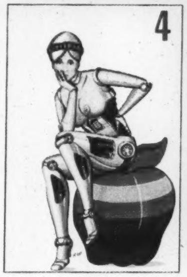

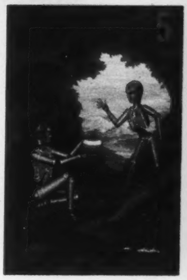

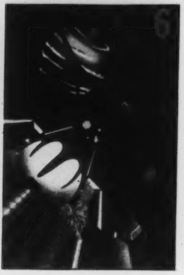

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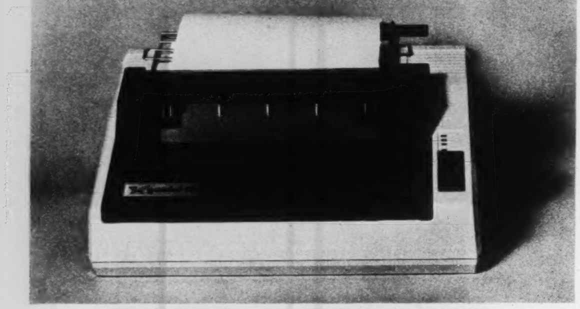

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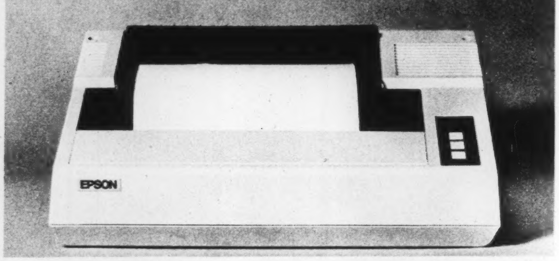

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```
1400 '    CLIP Q1,Q2,Q3,Q4
1410 IF Q1>=Q2 OR Q3>=Q4 THEN PRINT "Error in CLIP parameters.": END
1420 IF Q1<QWXL OR Q1>QWXR THEN QCXL=QWXL ELSE QCXL=Q1
1430 IF Q2<QWXL OR Q2>QWXR THEN QCXR=QWXR ELSE QCXR=Q2
1440 IF Q3<QWYB OR Q3>QWYT THEN QCYB=QWYB ELSE QCYB=Q3
1450 IF Q4<QWYB OR Q4>QWYT THEN QCYT=QWYT ELSE QCYT=Q4: RETURN

1500 '    UNCLIP
1510 QCXL=QWXL: QCXR=QWXR: QCYB=QWYB: QCYT=QWYT: RETURN

1600 '    COLOR Q1
1610 IF Q1>=0 AND Q1<=3 THEN QCOLOR%=Q1
1620 RETURN

1700 '    MOVE QX,QY
1710 QXCURNT=QXCURNT+QX: QYCURNT=QYCURNT+QY: RETURN

1800 '    MOVETO QX,XY
1810 QXCURNT=QX: QYCURNT=QY: RETURN

1900 '    DRAW QX,QY
1910 QX=QXCURNT+QX: QY=QYCURNT+QY

2000 '    DRAWTO QX,QY
2010 QXSAVE=QX: QYSAVE=QY: GOSUB 2020: QXCURNT=QXSAVE: QYCURNT=QYSAVE: RETURN

2020 '    SIGCLP QXCURNT,QYCURNT,QX,QY
2022 QXT=QXCURNT: QYT=QYCURNT: GOSUB 2046: QCODE1%=QCODE%
2024 QXT=QX: QYT=QY: GOSUB 2046: QCODE2%=QCODE%
2026 IF QCODE1%=0 AND QCODE2%=0 THEN 2042
2028 IF QCODE1% AND QCODE2% THEN RETURN
2030     IF QCODE1%=0 THEN QCODE%=QCODE2% ELSE QCODE%=QCODE1%
2032     IF QCODE%>=8 THEN QXT=QXCURNT+(QX-QXCURNT)*(QCYT-QYCURNT)/(QY-QYCURNT):
             QYT=QCYT: GOTO 2040
2034     IF QCODE%>=4 THEN QXT=QXCURNT+(QX-QXCURNT)*(QCYB-QYCURNT)/(QY-QYCURNT):
             QYT=QCYB: GOTO 2040
2036     IF QCODE%>=2 THEN QYT=QYCURNT+(QY-QYCURNT)*(QCXR-QXCURNT)/(QX-QXCURNT):
             QXT=QXCR: GOTO 2040
2038     IF QCODE%>=1 THEN QYT=QYCURNT+(QY-QYCURNT)*(QCXL-QXCURNT)/(QX-QXCURNT):
             QXT=QCXL
2040 IF QCODE%=QCODE1% THEN QXCURNT=QXT:QYCURNT=QYT:GOSUB 2046: QCODE1%=QCODE%:
     GOTO 2026 ELSE QX=QXT: QY=QYT: GOSUB 2046: QCODE2%=QCODE%: GOTO 2026
2042 QVX1=QWVXM * QXCURNT + QWVXA: QVY1=QWVYM * QYCURNT + QWVYA
2044 QVX2=QWVXM * QX + QWVXA: QVY2=QWVYM * QY + QWVYA: GOSUB 2058: RETURN

2046 '    SIGCOD QXT,QYT,QCODE%
2048 QCODE%=0: IF QXT<QCXL THEN QCODE%=QCODE%+1
2050 IF QXT>QCXR THEN QCODE%=QCODE%+2
2052 IF QYT<QCYB THEN QCODE%=QCODE%+4
2054 IF QYT>QCYT THEN QCODE%=QCODE%+8
2056 RETURN

2058 '    SIGDRW QVX1,QVY1,QVX2,QVY2
2060 QVX1=INT(QVX1*319): QVY1=199-INT(QVY1*199)
2062 QVX2=INT(QVX2*319): QVY2=199-INT(QVY2*199)
2064 LINE (QVX1,QVY1)-(QVX2,QVY2),QCOLOR%: RETURN

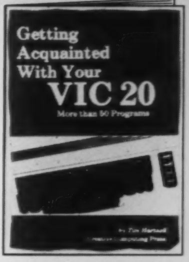
2100 '    FRAME
2110 QXSAVE2=QXCURNT: QYSAVE2=QYCURNT: QX=QCXL: QY=QCYB: GOSUB 1800: QX=QCXR:
     GOSUB 2000: QY=QCYT: GOSUB 2000: QX=QCXL: GOSUB 2000: QY=QCYB: GOSUB 2000:
     QXCURNT=QXSAVE2: QYCURNT=QYSAVE2: RETURN

2200 '    GRID Q1,Q2,Q3,Q4
2210 QGRID%=1: GOTO 2320

2300 '    AXES Q1,Q2,Q3,Q4
2310 QGRID%=0
2320 IF Q1=0 OR Q2=0 THEN PRINT "Error in AXES/GRID parameters.": END
2325 QXSAVE2=QXCURNT: QYSAVE2=QYCURNT
2330 QX=QCXL: QY=Q4: GOSUB 1800
2340 FOR QX=(QCXL\Q1)*Q1 TO QCXR STEP Q1
2350     IF QGRID%=1 THEN QY=QCYT: GOSUB 1800: QY=QCYB: GOSUB 2000
2355     IF QGRID%=0 THEN QY=Q4: GOSUB 2000: LINE -STEP(0,2),QCOLOR%:
             LINE -STEP(0,-4),QCOLOR%: LINE -STEP(0,2),QCOLOR%
2360     NEXT
2365 IF QGRID%=0 THEN QX=QCXR: QY=Q4: GOSUB 2000
2370 QX=Q3: QY=QCYB: GOSUB 1800
2380 FOR QY=(QCYB\Q2)*Q2 TO QCYT STEP Q2
2385     IF QGRID%=1 THEN QX=QCXL: GOSUB 1800: QX=QCXR: GOSUB 2000
2388     IF QGRID%=0 THEN QX=Q3: GOSUB 2000: LINE -STEP(-2,0),QCOLOR%:
             LINE -STEP(4,0),QCOLOR%: LINE -STEP(-2,0),QCOLOR%
2389     NEXT
2390 IF QGRID%=0 THEN QX=Q3: QY=QCYT: GOSUB 2000
2395 QXCURNT=QXSAVE2: QYCURNT=QYSAVE2: RETURN

2400 '    PAUSE
2410 Q$=INKEY$: IF Q$<>" " THEN 2410 ELSE RETURN
```

GUIDE TO VIC®-20 PROGRAMMING



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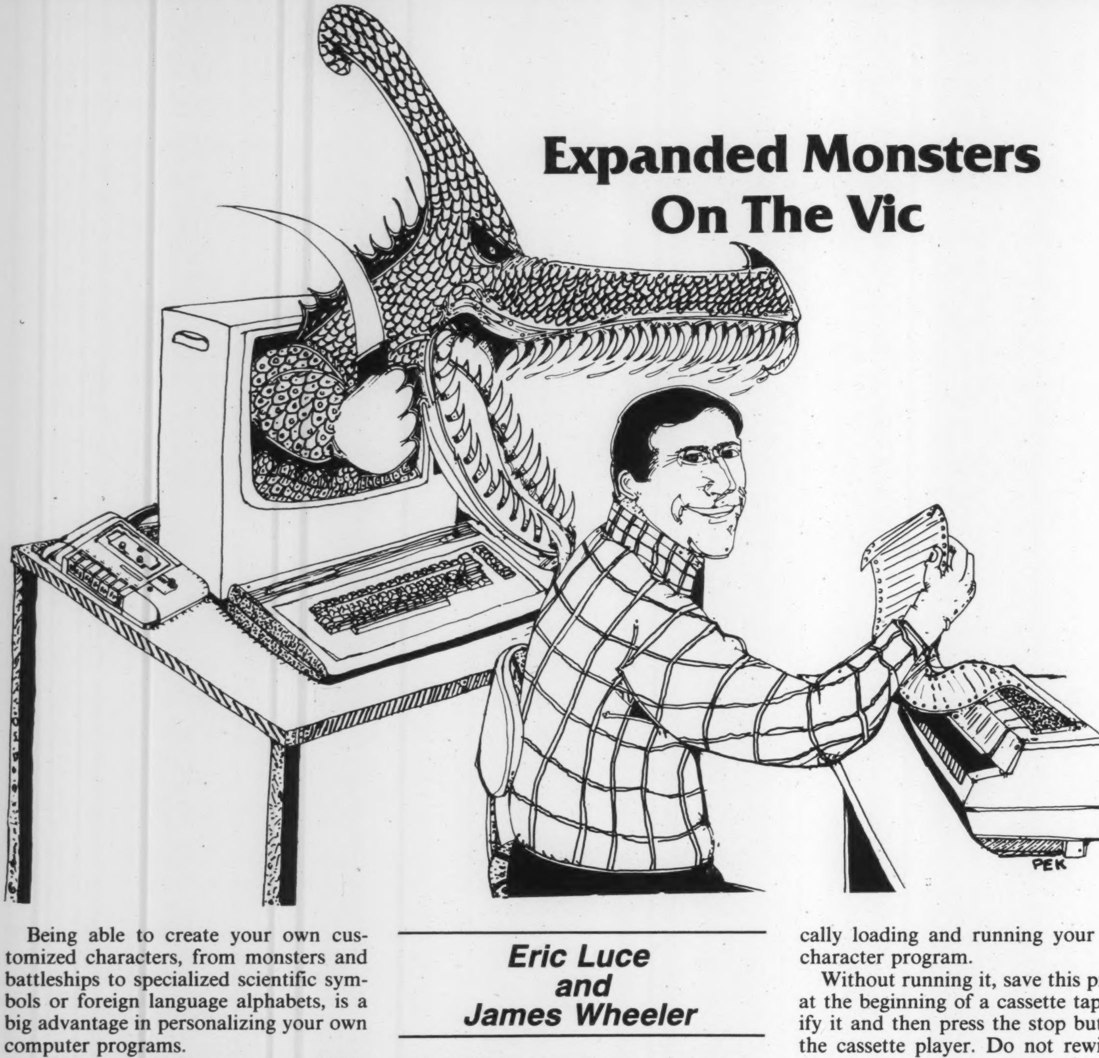

Eric Luce and James Wheeler

Being able to create your own customized characters, from monsters and battleships to specialized scientific symbols or foreign language alphabets, is a big advantage in personalizing your own computer programs.

There are several programs available to Commodore Vic 20 owners which allow you to create individualized characters. One is Commodore's own cassette program, the *Programmable Character Set and Gamegraphics Editor.* Another, called "8x8 Create," appeared on pages 270 and 272 of the January 1983 issue of *Creative Computing.* Both programs will give you the data statements you need to design almost any figure from a tree to a spaceship and have direct access to it from the keyboard.

When completed, your customized villain or hero will be the size of a capital letter, although the Commodore program manual suggests that you join several shapes together to form larger figures.

A problem arises, however, when you try to use the new characters in a memory-expanded Vic—they won't work.

When you add memory to the Vic, it does some location shifting, and as a result the area in which you store your special characters is used for another purpose.

Fortunately, there is a method which will allow you to use your custom figures on an expanded Vic.

First, type in the lines in Listing 1 which POKE into the buffer the memory pointers to reserve memory for special characters at the beginning of user RAM. They also provide for automatically loading and running your special character program.

Without running it, save this program at the beginning of a cassette tape. Verify it and then press the stop button on the cassette player. Do not rewind the tape.

Next turn the computer off, then on and type

```
POKE 44,24:POKE 46,24:POKE
48,24:POKE 50,24:POKE
63,10:POKE 65,5:NEW
```

Hit the return key and disregard the syntax error message you get on the screen.

You are now ready to type in the data for your first special character. Begin with line number 10 (do not use any line numbers before 10). Other data statements for additional custom figures can be on lines 11 through 19 or any other number after 10 except those used in Listing 2.

Listing 1.

```
10 Poke198,8:Poke631,76:Poke632,111:Poke633,13:Poke634,82
20 Poke635,117:Poke636,50:Poke637,48:Poke638,13
30 Poke44,24:Poke46,24:Poke48,24:Poke50,24:new
40 end
```

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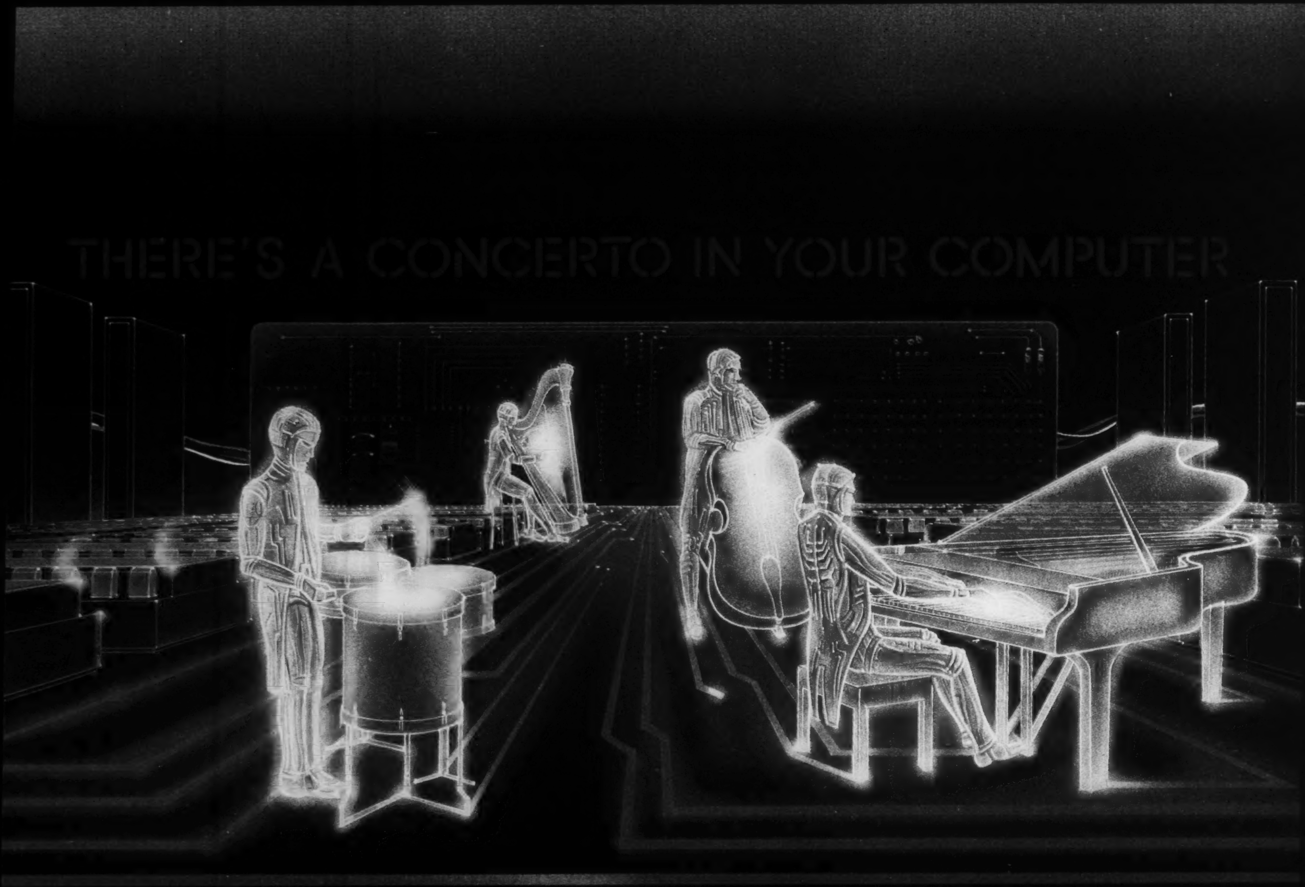

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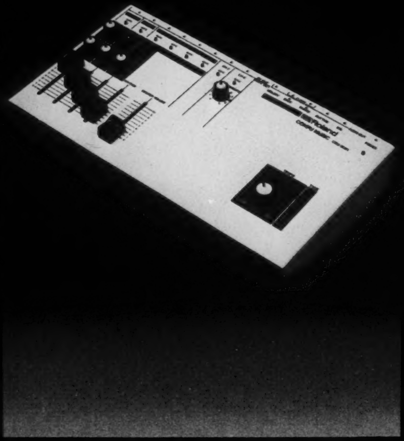

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The Roland CMU-800 Synthesizer retails for $495.00. The Compu-Music Software retails for $70.00 and is available for the Apple II and NEC computers. For more information, see your computer dealer or contact: RolandCorp US, 2401 Saybrook Avenue, Los Angeles, CA 90040 (213) 685-5141.

CIRCLE 255 ON READER SERVICE CARD

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Your last data statement must end with -99 to tell the computer where the character data ends. For example

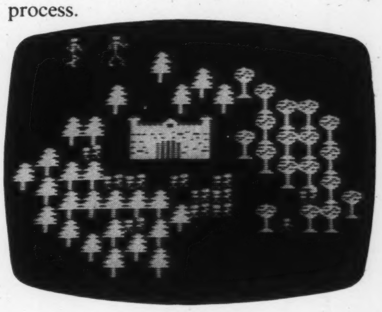
```
19 DATA 0,20,28,28,28,8,
   62,8,20,34,-99
```

Now type in Listing 2, omitting the REM statements, if necessary, to conserve memory.

Continue by adding your own program to this one, using 220 as your first line number. To run your program when you finish it, type the command RUN 20 (just RUN will result in a syntax error). Save your completed program on tape immediately following the saved first program (Listing 1) and verify it. Your cursor will look different, but don't worry. It will work fine.

The next time you want to load your program from tape, turn the computer off, then on. Rewind the tape to the beginning, and press the stop button. Hold down the Vic shift key, hit and release the run/stop key, and release the shift key. The program will run automatically. To run it a second time, type RUN 20.

If you forget to use this method and type LOAD instead, the program will load only partially. In this case just type RUN, which will complete the loading process.



Minotaur.

We have included the Minotaur program from *More Basic Computer Games* (Creative Computing Press, 1979) to provide a sample of the designs you can use. This game, which we have edited and adapted for the Vic, uses special characters for the villain (the Minotaur), the hero (you), a hunting net, stars, and an unidentified fellow with a hunting horn. To type it in, first type in the program in Listing 1 and save it as directed previously. Turn the computer off, then on, and type

```
POKE 44,24:POKE 46,24:POKE 48,
24:POKE 50,24:POKE 63,10:
POKE 65,5:NEW
```

Hit the RETURN key (disregarding the error message), and add the Minotaur program as listed. Save it, verify it, and load it according to the directions in the preceding paragraphs. It requires an 8K expander. ☐

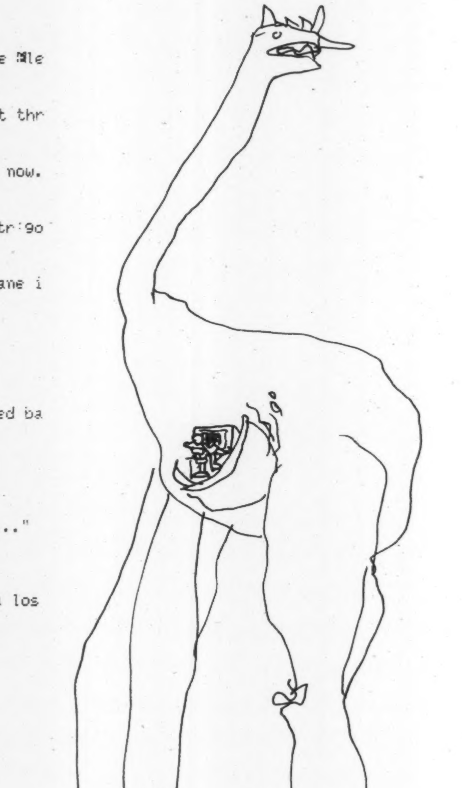
Listing 2.

```
10 rem rePlace this rem with your first data statement
20 fori=5120to6144:rem set looP to move char. data to ram
30 Pokei,Peek(i+27648):rem move char. data to ram
40 nexti
45 Poke36869,205:rem tell vic where char.'s are
50 rem *** the data must start at line 10 ***
60 rem the followin9 lines modify the char.'s
70 rem in ram startin9 at 5120 decimal.
80 rem the first no. in the data statement
90 rem is the char. you wish to modify
130 Poke 63,10:Poke65,5:rem tell vic where data starts
140 read zz:rem read which char. to modify
150 ifzz=-99 then220
160 fori=5120+zz*8 to 5127+zz*8:rem set looP for char.
180 read zc
190 Pokei,zc:rem Place char. data in ram
200 nexti
210 9oto140
220 rem here is where your Pro9ram starts
```

Minotaur listing.

```
10 data 0,20,28,28,8,62,8,20,34
11 data91,28,28,8,28,42,8,20,34
12 data92,60,92,190,93,190,93,62,54
13 data93,195,163,65,162,65,162,193,201
14 data94,255,255,255,255,255,255,255,255
15 data95,40,84,170,85,170,85,42,20
16 data97,112,112,32,120,165,34,80,136
17 data98,112,112,32,114,174,32,80,136
18 data99,112,112,34,126,160,32,80,136
19 data100,112,114,46,112,160,32,80,136
20 data101,114,126,40,112,160,32,80,136
21 data102,3,34,34,44,208,16,16,96
22 data103,0,32,38,36,196,24,0,0
23 data104,0,0,16,40,16,0,0,0
24 data105,0,0,20,8,20,0,0,0
25 data31,16,16,16,16,16,84,56,16,-99
30 Poke44,24
35 Print"█"chr$(142)chr$(8)"settin9 uP characters"
40 fori=4608to6144:Pokei,Peek(i+29696):nexti
45 Poke36869,205:Poke63,10:Poke65,5
50 readzz:ifzz=-99then80
55 fori=5120+(zz*8)to5127+(zz*8):readzc
60 Pokei,zc:nexti:9oto50
80 zz=rnd(-ti):Print"██        █MINOTAUR
120 Printtab(10)"██by":Print"█ 'CREATIVE COMPUTING'":Print"Morristown, New Jersey
121 Print"█████Edited by Eric Luce":Print"and James Wheeler.
128 hP=230:9osub6200:Print"██        █MINOTAUR":9osub5700:9osub5800
162 l1=int(rnd(1)*3)+1:x1=int(rnd(1)*(-21))+11:y1=int(rnd(1)*(-21))+11:sf=36877
190 Print"███":dimb(10),c(10):9osub1350:9osub1670:9osub2340:9osub2420:sv=36878:c
c=.9999
290 ifx2=s1andy2=s2andl2=s3andt>1then3690
310 ifx1=x2andy2=1andl1=l2then3670
330 cc=cc↑1.78:ifrnd(1)>ccthen2850
360 t=t+1:9osub6000:Print"Turn"t". Minotaur is":Print"at ("x1","y1"), Level"l1
365 Print"You're at ("x2","y2"),  level"l2".
366 ifrnd(1)<.177thenhP=51:9osub6200
370 inPut"█command";z$
390 ifz$="e"thenx2=x2+f:9oto400
391 ifz$="w"thenx2=x2-f:9oto400
392 ifz$="n"theny2=y2+f:9oto400
393 ifz$="s"theny2=y2-f:9oto400
395 ifz$="u"andl2<3thenl2=l2+1:9osub5900:9oto500
396 ifz$="d"thenl2=l2-1:9osub5930:9oto500
397 ifz$="net"then560
398 ifz$="helP"then3270
399 t=t-1:9oto360
400 ifabs(x2)>10orabs(y2)>10then1160
410 9osub5700:9oto1200
500 ifl2>3orl2<1then1330
510 9oto1200
560 ifl1<>l2then1080
570 ifx1<>x2andy1<>y2then1100
580 if(x1<>x2andabs(y1-y2)>10)orabs(x1-x2)>10then1120
600 ifs9=1then3720
610 Print"█What direction":inPut"(e, w, n, s)";h1$
630 inPut"How far";h2:Print:s5=x2:s6=y2
680 forh3=1toh2:ifh1$="e"thens5=s5+1:9oto700
682 ifh1$="w"thens5=s5-1:9oto700
```

```
684 ifh1$="n"thens6=s6+1:9oto700
686 s6=s6-1
700 ifabs(s5)>10orabs(s6)>10then860
790 foree=1to100:nextee:s1=s5:s2=s6:s3=l2:s9=1:9osub6000
810 fora=1to10:ifs5=b(a)ands6=c(a)then850
830 nexta:9oto870
850 forr=1to3000:nextr:Print"■":9osub4180
855 Print"■■ZZZT! Your net hit":Print"barrier #";a;"":Print"■
857 forr=1to3000:nextr:9oto1140
870 nexth3
880 ifs5<>x1ors6><y1then1010
890 ifrnd(1)<.5then6100
900 onint(rnd(1)*2)+19oto901,1070
901 Print"You 9ot the minotaur":Print"but it escaPed!":9oto1010
910 Print"You 9ot the Minotaur":Print"in"t"turns.■":9oto1470
930 inPut"Play a9ain";x$
950 ifri9ht$(x$,1)="n"then3752
970 clr:9oto162
1010 Print"■Net is at":Print"("s5","s6"). you":Print"must 9et it.■"
1016 s1=s5:s2=s6:s3=l2:s9=1:9oto1090
1070 9osub2840
1080 Print"■■You can only throw":Print"when you are both":Print"on the ■same ■le
vel.■
1090 forjz=1to5500:next:9oto290
1100 Print"■■You are on a dia9onal":Print"to the Minotaur; you":Print"cannot thr
ow now.■
1110 9oto1090
1120 Print"■■You are not within ■10■":Print"sPaces. You cannot":Print"throw now.
■
1130 9oto1090
1140 Print"■You are now without":Print"a net... You lose!":forr=1to4000:nextr:9o
to930
1160 Print"■":Poke36879,8:9osub5600
1165 Print"■■■■■■AAAAAAAAAH! You fell":Print"off the ed9e of the":Print"Plane i
nto  a cre-
1167 Print"vasse!":forr=1to950:nextr:9osub5620
1169 Poke36879,27:Print"■■■■":9oto930
1200 fora=1to10:ifx2=b(a)andy2=c(a)then1240
1220 nexta:9oto1270
1240 Print"■":9osub4180
1245 Print"■■You have just fried":Print"your niblets on an":Print"electrified ba
rrier!■
1247 forr=1to3000:nextr:9oto930
1270 x=int(rnd(1)*10)+1:ifx=5then1300
1290 9oto2520
1300 Print"■":Poke36879,8:9osub5640
1305 Print"■■■■■AAAAAAAAAH! TraPdoor-":Print"you fell down one":Print"level..."
1306 forr=1to650:nextr:9osub5620
1310 Poke36879,27:Print"■■■■":l2=l2-1
1320 ifl2>0thenPrint"■■■";:Poke36879,27:Print"■":9oto1290
1330 Print"■■Worse yet, you fell":Print"out of the cavern":Print"and.....you los
e.
1332 forr=1to5800:nextr:Poke36879,27:Print"■■■■":9oto930
1350 inPut"Want to be a chamPion";x9$
1370 ifri9ht$(x9$,1)="n"then1440
1390 c2=20:Print"■Then you must caPture":Print"it within 10 moves.
1440 return
1450 ifleft$(x9$,1)="n"then930
1470 c3=(2/t)*100:ifc3<20then1630
1480 Print"You are now a quali-":Print"fied ■ChamPion■!■":9oto930
1630 Print"■Sorry, you did not":Print"qualify as chamPion.■":9oto930
1670 Print:forv7=1to22:Print"■*■";:nextv7
1740 Print"■■■Want instructions■":inPutx$
1770 ifleft$(x$,1)="n"then2320
1800 Print"■■The object is to caP-":Print"ture the Minotaur":Print"with your net
.■■
1813 forv8=1to22:Print"■*■";:nextv8:Print"■■":9osub2395
1830 Print"■■     THE CAVERN■■
1840 Print"The cavern of the":Print"Minotaur has three
1850 Print"levels. Each level":Print"is a coordinate":Print"Plane.
1860 Print"■Outside the levels":Print"is a deeP crevasse.■
1870 Print"The Planes stretch":Print"10 sPaces on each
1880 Print"axis from the ori9in.■
1882 9osub2395
1938 Print"■":fore=1to3
1940 Print"        ■HAZARDS■":forw=1to400:nextw:Print"■                    "
1942 forq=1to500:nextq:nexte
1961 Print"■■
1962 Print"  ■BARRIERS■:
1970 Print"■Inside the cavern are":Print"10 electrified Pil-
1980 Print"lars that extend":Print"strai9ht uP (↑)" :Print"throu9h the three
```



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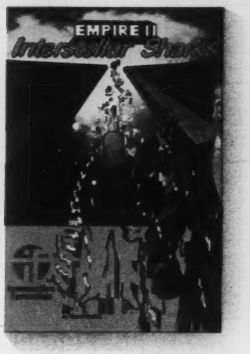

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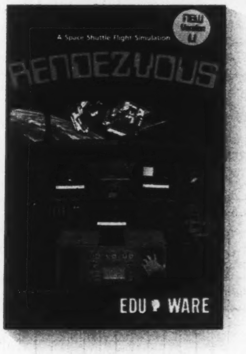

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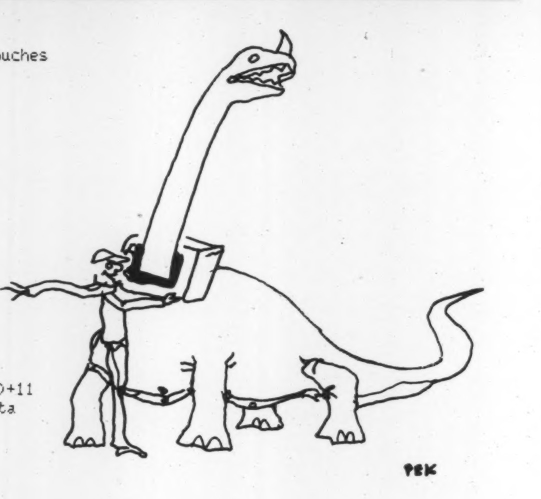
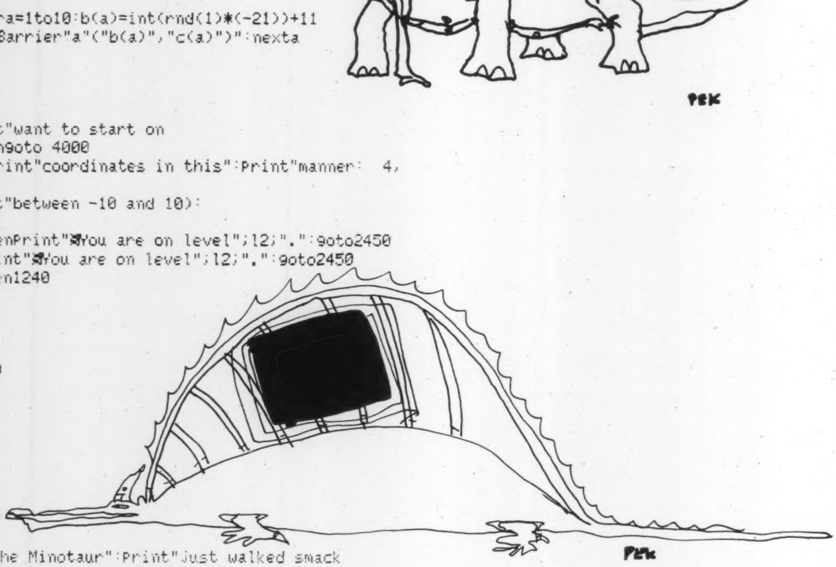
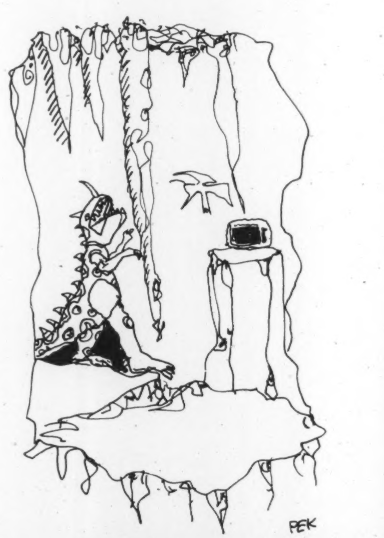
CIRCLE 160 ON READER SERVICE CARD

Vic Monsters, continued...



```
1990 Print"levels.":Print"They will destroy":Print"anything that touches
2000 Print"them!!!■
2020 Print"  TRAPDOORS:
2030 Print"■TraPdoors will aPPear":Print"out of nowhere and
2040 Print"droP you down (←) one":Print"level. If you were on
2050 Print"level 1, you lose!":9osub2395
2070 Print"■■■     ■MINOTAUR■■■■
2080 Print"The Minotaur will":Print"char9e if you miss
2090 Print"with your net.":Print"■■Also, it may char9e"
2100 Print"for no reason at all!■":9osub2395
2130 Print"■■Your commands are:
2140 Print"■e=move east
2150 Print"w=move west":Print"n=move north":Print"s=move south■
2160 Print"u=move uP a level":Print"d=move down a level
2165 Print"net=throw the net■
2200 Print"helP=list commands"
2300 Print"■■Have fun...■■":9osub2395
2320 return
2340 Print"■■  The barriers are:■":fora=1to10:b(a)=int(rnd(1)*(-21))+11
2370 c(a)=int(rnd(1)*(-21))+11:Print"Barrier"a"("b(a)","c(a)")":nexta
2395 Print"■■  TyPe any letter...
2400 9et9$:if9$=""then2400
2410 return
2420 l2=9
2430 Print"■■Which level do you":Print"want to start on
2443 inPutl2:x2=15:ifl2<1 or l2>3 then9oto 4000
2450 Print"■■TyPe in your startin9":Print"coordinates in this":Print"manner:  4,
3 "
2455 Print"(whole numbers only,":Print"between -10 and 10):
2456 inPutx2,y2
2457 ifx2>10orx2<-10ory2>10ory2<-10thenPrint"■You are on level";l2;".":9oto2450
2460 ifint(x2)<>x2orint(y2)<>y2thenPrint"■You are on level";l2;".":9oto2450
2462 fora=1to10:ifx2=b(a)andy2=c(a)then1240
2466 nexta:f=1
2490 Print:return
2520 x4=x1:y4=y1:l4=l1
2550 x3=int(rnd(1)*5)+1
2560 onx3 9oto2570,2620,2640,2710,2760
2570 x1=x1+1
2580 ifabs(x1)>10then2600
2590 9oto2780
2600 x1=x4:9oto2550
2620 x1=x1-1:9oto2580
2640 y1=yi+1
2650 ifabs(y1)>10then2670
2660 9oto2780
2670 y1=y4:9oto2550
2690 forr=1to1500:nextr:Print"■■Hey! the Minotaur":Print"Just walked smack
2695 Print"dab into a barrier!!":forr=1to3800:nextr:9oto3180
2700 9oto2650
2710 l1=l1+1
2720 ifl1>3orl1<1then2740
2730 9oto2780
2740 li=l4:9oto2550
2760 l1=l1-1:9oto2720
2780 fora=1to10:ifx1=b(a)andyi=c(a)then2550
2800 nexta:Print:9oto290
2840 Print"   ■■You 9ot the":Print"Minotaur, but it escaPed■■"
2850 Print"Bronco Na9urski!!■":Print"The Minotaur is":Print"CHARGING...."
2855 fore=1to2000:nexte:Pokesv,15
2860 x3=s9n(x2-x1):y3=s9n(y2-y1):l3=s9n(l2-l1)
3000 ifl1=l2then3050
3010 l1=l1+l3:Print"Level"l1:9oto3000
3050 ifx1=x2then3100
3060 x1=x1+x3:9osub3140
3080 fore=1to100:nexte:9osub6000:Poke36874,200:fore=1to20:nexte:Poke36874,0:9oto
3050
3100 ify1=y2then3210
3110 y1=y1+y3:9osub3140:9oto3080
3140 forP=1to10:ifb(P)=x1andc(P)=y1then3180
3160 nextP:return
3180 Print"■":9osub4180
3186 Print"■ZZZZZZT■! The Minotaur":Print"Just fried itself.
3188 forr=1to3000:nextr:Print"you win, hero!":forr=1to3000:nextr:9oto1450
3210 Print"■OH, NO! You're in":Print"for it now!!":forr=1to3000:nextr:9osub5200:
9oto930
3270 Print"■Commands:":Print" e=9o east":Print" w=9o west":Print" n=9o north
3280 Print" s=9o south■":Print" u=9o uP":Print" d=9o down":Print" net=throw net■
"
3290 Print" helP=list commands"
3300 9osub2395:Print"■";:9oto290
```





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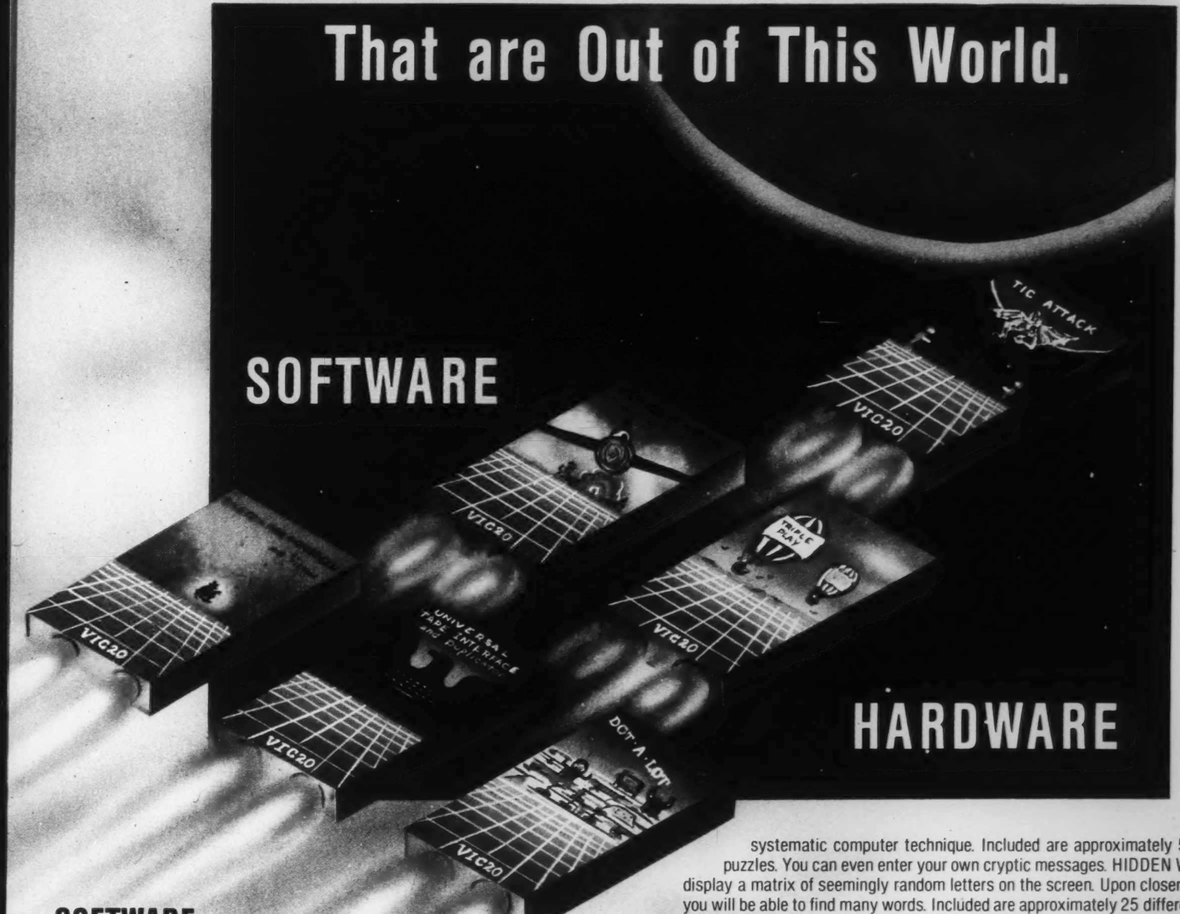

SOFTWARE

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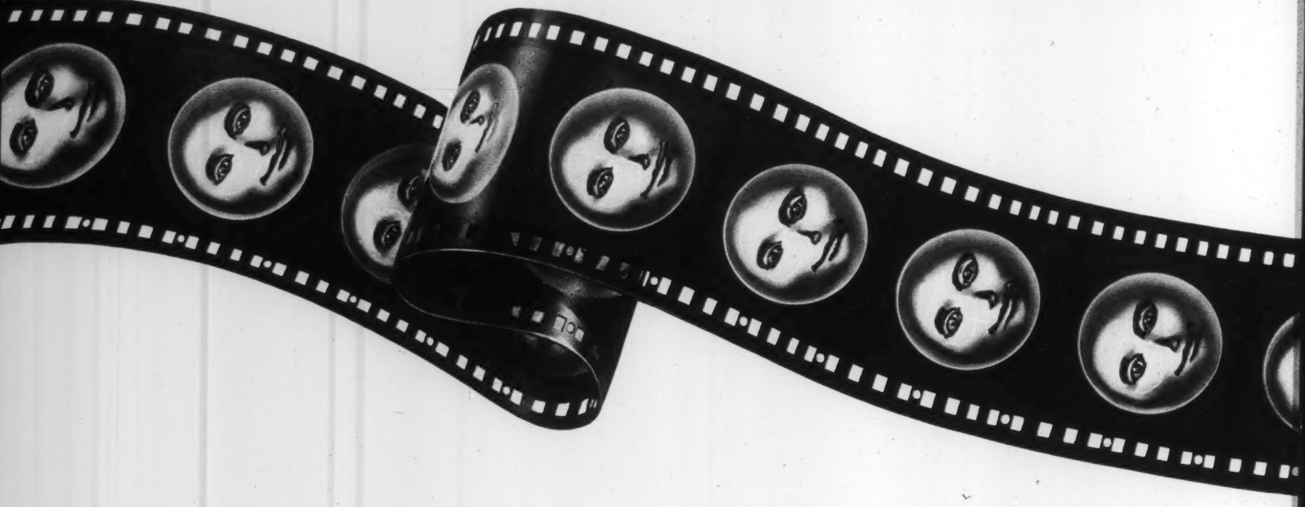

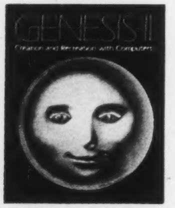
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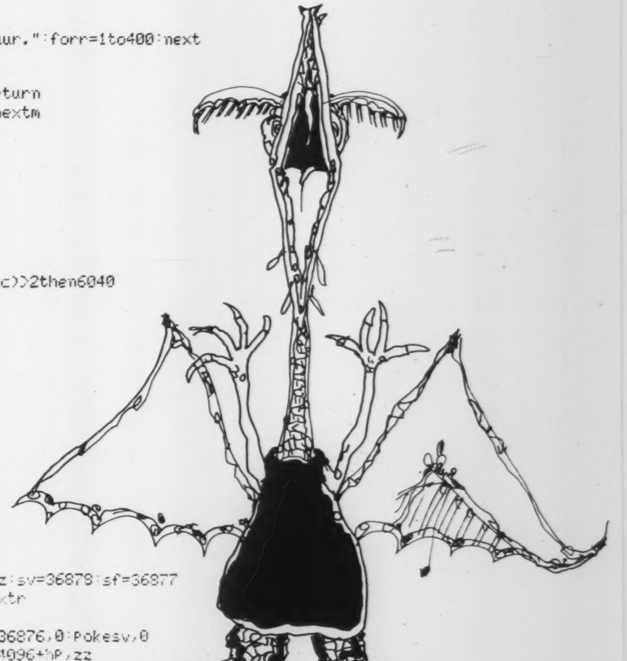
CIRCLE 232 ON READER SERVICE CARD

Vic Monsters, continued...

```
3670 print"Minotaur moved to":print"your spot.":forjz=1to2000:nextjz:gosub5200:g
oto930
3690 print"You have your net.":s9=0:forjz=1to2000:nextjz:goto310
3720 print"How can you throw":print"your net if you don't":print"have one?
3730 print"Net is at ("s1","s2")":print"on level"s3:goto1090
3752 print"▓▓▓  ":print"Ok, maybe the tension":print"was kind of exhaust-":print
"ing.▓▓
3753 print"Gather your courage,":print"though, and return":print"soon to the fea
rsome▓▓"
3754 print"▓Cave of the MINOTAUR▓▓▓"
3760 poke36869,192:printchr$(9)chr$(14);:end
4000 print"▓You're not even in":print"the cavern!
4010 forw=1to3700:nextw:goto2430
4100 pokesf,220:forl=15to0step-1:pokesv,l:form=1to150:nextm
4180 pokesf,220:forl=15to0step-1.5:pokesv,l:form=1to150:nextm
4210 forr=1to5:poke36879,127:forw=1to5:nextw
4220 poke36879,47:forw=1to5:nextw
4230 poke36879,42:forw=1to5:nextw
4235 nextr:nextl
4240 poke36879,8:forkt=1to1500:nextkt:poke36879,27
4250 pokesf,0:pokesv,0:return
5200 poke36879,8:print"▓▓":forkt=1to50:w=int(rnd(1)*511)+1
5210 poke4096+w,int(104.5+rnd(1)):nextkt
5230 print"▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓In fact, it's just "
5235 print"thrown you out into ":print"the starry night!":gosub5400
5238 print"▓(Windy, isn't it?)":gosub5400
5239 pokesv,0:pokesf,0
5240 print"▓▓▓▓";:poke36879,27:return
5400 ss=180:pokesf,ss:forl=1to2:d=int(rnd(1)*5)*22+50:form=2to14step2
5405 ss=ss+int(rnd(1)*10):pokesf,ss
5410 pokesv,m:forn=1tod:nextn:nextm:form=15to3step-1:pokesv,m
5415 ss=ss-int(rnd(1)*10):pokesf,ss
5420 forn=1tod:nextn:nextm:nextl:return
5600 poke36878,10:forl=230to128step-1:poke36876,l:form=1to20:nextm
5610 nextl:poke36876,0:return
5620 pokesf,200:forl=15to0step-.05:pokesv,l:fory=1to8:nexty:nextl:pokesf,0:return
5640 pokesv,10:forl=230to128step-1:poke36876,l:form=1to7:nextm
5650 nextl:poke36876,0:return
5700 poke sv,15:forl=1to5:poke36874,200:form=1to20:nextm:poke36874,0
5710 form=1to450:nextm:nextl:poke36878,0:poke36874,0:return
5800 pokesv,15:b=0
5810 forr=1to650:nextr
5820 forl=128 to 233 step11:poke36874,l
5830 form=1to30:nextm:b=b+1
5850 ifb=3thenb=0:poke36874,0
5860 nextl:poke36874,0:pokesv,0:forr=1to400:nextr
5870 print"▓▓Welcome to the cave":print"of the awful Minotaur.":forr=1to400:next
r:goto5700
5900 pokesv,15:forzz=200to225step5:poke36874,zz:form=1to10
5910 nextm:poke36874,0:form=1to450:nextm:nextzz:pokesv,0:return
5930 pokesv,15:fork=225to200step-5:poke36874,k:form=1to20:nextm
5940 poke36874,0:form=1to450:nextm:nextk:pokesv,0:return
6000 print"▓▓▓▓▓▓";:forzz=0to4:forzx=0to4
6005 poke37888+zz+zx*22,0
6010 nextzx:nextzz
6011 print"▓▓▓▓▓▓You-+"
6012 print"▓▓▓▓▓▓▓▓▓▓▓▓Minotaur-▓▓▓"
6013 print"▓▓▓▓▓▓▓▓▓▓▓▓barrier-▓▓▓"
6014 print"▓▓▓▓▓▓▓▓▓▓▓▓net-▓▓▓":poke4142,91
6020 forzz=1to10:zb=b(zz)-x2:zc=y2-c(zz):ifabs(zb)>2orabs(zc)>2then6040
6030 poke4142+zb+zc*22,94:poke37934+zb+zc*22,2
6040 nextzz:ifs3<>l2ors9=0then6060
6045 zb=s1-x2:zc=y2-s2:ifabs(zb)>2orabs(zc)>2then6060
6050 poke4142+zb+zc*22,95:poke37934+zb+zc*22,7
6060 ifl1<>l2then6090
6065 zb=x1-x2:zc=y2-y1:ifabs(zb)>2orabs(zc)>2then6090
6070 poke37934+zb+zc*22,4
6075 ifs1<>x1ors2<>y1orl1<>s3then6080
6076 poke4142+zb+zc*22,92:goto6090
6080 poke4142+zb+zc*22,0
6090 print"▓▓▓▓":return
6100 zz=93:zb=x1-x2:zc=y2-y1:ifabs(zb)>2orabs(zc)>2then910
6110 foriz=1to30:poke4142+zb+zc*22,zz:forjz=1to100:nextjz
6120 zz=abs(zz-93)+92:nextiz:goto910
6200 poke37888+hp,0:poke37867+hp,3:poke37846+hp,3
6210 forzz=97to101:poke4096+hp,zz:forjz=1to300:nextjz:nextzz:sv=36878:sf=36877
6220 poke4075+hp,103:pokesv,10:poke36876,130:forr=1to525:nextr
6230 poke4075+hp,102:poke4054+hp,103:poke36876,200
6240 forl=10to0step-1:pokesv,l:forr=1to500:nextr:nextl:poke36876,0:pokesv,0
6250 poke4075+hp,32:poke4054+hp,32:forzz=101to97step-1:poke4096+hp,zz
6260 forj=1to300:nextj:nextzz:return
```



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S-100 MEMORY BOARDS

64K STATIC RAM - Jade

Uses new 2K x 8 static RAMs, fully supports IEEE 696 24 bit extended addressing, 200ns RAMs, lower 32K or entire board phantomable, 2716 EPROMs may be subbed for RAMs, any 2K segment of upper 8K may be disabled, low power typically less than 500ma.

MEM-99152B	*Bare board*	**$49.95**
MEM-99152K	*Kit less RAM*	**$99.95**
MEM-32152K	*32K kit*	**$199.95**
MEM-56152K	*56K kit*	**$289.95**
MEM-64152K	*64K kit*	**$299.95**
Assembled & Tested		**add $50.00**

256 RAMDISK - SD Systems

ExpandoRAM III expandable from 64K to 256K using 64 x 1 RAM chips, compatible with CP/M, Oasis, & most other Z-80 based systems, functions as ultra-high speed disk drive when used with optional RAMDISK software

MEM-65064A	*64K A & T*	**$474.95**
MEM-65128A	*128K A & T*	**$574.95**
MEM-65192A	*192K A & T*	**$674.95**
MEM-65256A	*256K A & T*	**$774.95**
SFC-55009000F	*RAMDISK sftwr CP/M 2.2*	**$44.95**
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SUPERQUAD - Adv. Micro Digital

Single board standard size S-100 computer system, 4MHz Z-80A single or double density disk controller for 5¼" or 8" drives, 64K RAM, extended addressing up to 4K of EPROM 2 serial & 2 parallel I/O ports, real time interrupt clock, CP/M compatible

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Clear Plexiglass storage boxes for up to 75 Diskettes

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Letter Quality Printer - BMC

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PRD-52002	*Serial*	**$829.00**
PRA-52000	*Tractor option*	**$159.95**

380Z by Data Terminals & Communications

Based on the same quality mechanism as the Comrex printer, the 380Z contains electronic enhancements that allow it to print at speeds up to 32 CPS. Other features include a 48K buffer, proportional spacing, and Diablo 1640/1650/630 compatible protocol. Comes with printwheel, ribbon and users manual. Serial, parallel, and IEEE 488 interfaces standard

PRD-11300	*380Z printer*	**$1295.00**
PRA-11000	*Tracor option*	**$169.95**
PRA-12000	*Cut Sheet Feeder*	**$699.95**

Printers From Jade

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OKIDATA 84	*15" 200 CPS With Graphics*	**CALL**
OKIDATA 2350	*15" 350 CPS*	**CALL**
OKIDATA 2410	*15" 350 CPS*	**CALL**
DAISYWRITER 2000	*48K Daisywheel*	**$1395.00**
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DUAL DISK SUB SYSTEMS

Disk Sub-Systems - Jade

Handsome metal cabinet with proportional balanced air flow system, rugged dual drive power supply, power cable kit, power switch, line cord, fuse holder, cooling fan, nevermar rubber feet, all necessary hardware to mount 2-8" disk drives, power supply, and fan, does not include signal cable.

Dual 8" Sub-Assembly Cabinent

END-000420	*Bare cabinent*	**$49.95**
END-000421	*Cabinent kit*	**$199.95**
END-000431	*A & T*	**$249.95**

8" Sub-Systems - Single Sided, Double Density

END-000423	*Kit w/2 Siemens FD100-8Ds*	**$650.00**
END-000424	*A & T w/2 Siemens FD100-8Ds*	**$695.00**
END-000433	*Kit w/2 Shugart SA-801Rs*	**$999.95**
END-000434	*A & T w/2 Shugart SA-801Rs*	**$1195.00**

8" Sub-Systems - Double-Sided Double-Density

END-000426	*Kit w/2 Qume DT-8s*	**$1224.95**
END-000427	*A & T w/2 Qume D-8s*	**$1424.95**
END-000436	*Kit w/2 Shugart SA-851Rs*	**$1274.95**
END-000437	*A & T w/2 Shugart SA-851Rs*	**$1474.95**

8" SLIMLINE SUB-SYSTEMS

Dual Slimline Sub-Systems - Jade

Handsome vertical cabinet with scratch resistant baked enamel finish, proportionally balanced air flow system, quiet cooling fan, rugged dual drive power supply, power cables, power switch, line cord, fuse holder, colling fan, all necessary hardware to mount 2-8" slimline disk drives, does not include signal cable

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END-000820	*Bare cabinet*	**$59.95**
END-000822	*A & T w/o drives*	**$179.95**

Dual 8" Slimline Sub-Systems

END-000823	*Kit w/2 SS DD*	**$919.95**
END-000824	*A & T w/2 SS DD*	**$949.95**
END-000833	*Kit w/2 DS DD*	**$1149.95**
END-000834	*A & T w/2 DS DD*	**$1179.95**

S-100 CPU BOARDS

SBC-200 - SD Systems

4 MHz Z-80A CPU with serial & parallel I/O, 1K RAM, 8K ROM space, monitor PROM included.

CPU-30200A	*A & T*	**$329.95**

THE BIG Z - Jade

2 or 4 MHz switachable Z-80 CPU board with serial I/O, accommodates 2798, 2716, or 2732 EPROM, baud rates from75 to 9600.

CPU-30201B	*Bare board w/manual*	**$35.00**
CPU-30201K	*Kit with Manual*	**$149.95**
CPU-30201A	*A & T with Manual*	**$199.95**

2810 Z-80 CPU - C.C.S.

2 or 4 Z-80 CPU with serial I/O port & on board monitor PROM, front panel compatible.

CPU-30400A	*A & T with Prom*	**$289.95**

CPU-Z CompuPro

2 or 4 MHz Z80A CPU, 24 bit addressing

CPU-30500A	*2/4 MHz A & T*	**$279.95**
CPU-30500C	*3 6 MHz CSC*	**$374.95**

8085/8088 - CompuPro

Both 8 & 16 bit CPUs, standard 8 bit S-100 bus, up to 8 MHz, accesses 16 Megabytes of memory.

CPU-20510A	*6 MHz A & T*	**$398.95**
CPU-20510C	*6/8 MHz CSC*	**$479.95**

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VDM-751210	*12" Amber*	**$139.95**

5¼" DISK DRIVES

Tandon TM100-1 single-sided double-density 48 TPI	**MSM-551001**	**$219.95 ea**	2 for **$199.95 ea**
Shugart SA400L single-sided double-density 40 track	**MSM-104000**	**$234.95 ea**	2 for **$224.95 ea**
Tandon TM100-2 double-sided double-density 48 TPI	**MSM-551002**	**$294.95 ea**	2 for **$269.95**
TEAC FD55A single-sided double-density 40 track	**MSM-660551**	**$299.95 ea**	2 for **$239.95**

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END-000226	*Dual cab w/power supply*	**$94.95**

S-100
MOTHERBOARDS

ISO-BUS - Jade

Silent, simple and on sale — a better motherboard

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MBS-061B	*Bare board*	**$22.95**
MBS-061K	*Kit*	**$39.95**
MBS-061A	*A & T*	**$69.95**
	12 Slot (9¾" x 8⅝")	
MBS-121B	*Bare board*	**$34.95**
MBS-121K	*Kit*	**$69.95**
MBS-121A	*A & T*	**$109.95**
	18 Slot (14½" x 8⅝")	
MBS-181B	*Bare board*	**$54.95**
MBS-181K	*Kit*	**$99.95**
MBS-181A	*A & T*	**$149.95**

8" DISK DRIVES

Siemens FDD 100-8 single-sided double-density	**MSF-201120**	**$274.95 ea**	2 for **$249.95 ea**
Shugart SA801R single-sided double-density	**MSF-10801R**	**$394.95 ea**	2 for **$389.95 ea**
Shugart SA851R double-sided double density	**MSF-10851R**	**$554.95 ea**	2 for **$529.95 ea**
Qume DT-8 double-sided double-density	**MSF-750080**	**$524.95 ea**	2 for **$498.95 ea**
Tandon TM8481 single-sided double-den thin-line	**MSF-558481**	**$379.96 ea**	2 for **$369.95 ea**
Tandon TM848-2 double-sided double-den thin-line	**MSF-558482**	**$494.95 ea**	2 for **$484.95**
NEC FD1165 double-sided double-den thin-line	**MSF-851165**	**$484.95 ea**	2 for **$449.95**

S-100 I/O BOARDS

THE BUS PROBE - Jade

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TSX-200B	*Bare board*	**$59.95**
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TSX-200A	*A & T*	**$159.95**

INTERFACER 4 - CompuPro

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IOI-1840A	*A & T*	**$314.95**
IOI-1830C	*CSC*	**$414.95**

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2 serial I/O ports plus 2 parallel I/O ports

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I/O-5 - SSM Microcomputer

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MODEMS

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IOM-5620A	*1200/300 baud Deluxe*	**$369.95**
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IOM-2010A	*Micromodem II w/term prgm*	**$329.95**
IOM-2012A	*Terminal program for MMII*	**$89.95**

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103/212 Smart Cat & 103 Smart Cat 1200 & 300 baud, built-in dialer, auto re-dial if busy, auto answer disconnect direct conect, LED readout displays mode, analog digital loopback self tests, usaable with multi-line phones

IOM-5241A	*300 baud 103 Smart Cat*	**$229.95**
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1/5 the size of ordinary modems, Bell 103, manual or auto-answer, automatic answer/orginate, direct connect, built-in self-test, two LEDs and audio beeps provide status information.

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NEW! CP/M Plus 3.0

CP/M 3.0 is Digital Research's latest version of the industry standard disk operating system. It features many performance improvements, such as intelligent record buffering, improved directory handling, "HELP" facility, time date stamping of files and many more improvements. A TREMENDOUS INCREASE IN SPEED!! it is fully CP/M 2.2 compatible and requires no changes to your existing application software. Available only to Versafloppy II owners with SBC-200 CPU's

SFC-55009059F	*Unbanked, RS232*	**$250.00**
SFC-55009058F	*Unbanked, VDB8024*	**$250.00**
SFC-55009057F	*Banked, RS232*	**$250.00**
SFC-55009056F	*Banked, VDB8024*	**$250.00**
SFC-55009057D	*Manual*	**$50.00**

S-100
EPROM BOARDS

PB-1 - SSM Microcomputer

2708, 2716 EPROM board with on-board programmer.

MEM-99510K	*Kit with manual*	**$154.95**
MEM-99510A	*A & T With Manual*	**$219.95**

PROM-100 - SD Systems

2708, 2716, 2732 EPROM programmer with software.

MEM-99520K	*Kit With software*	**$189.95**
MEM-99520A	*A & T With software*	**$249.95**

S-100
DISK CONTROLLERS

VERSAFLOPPY II - SD Systems

Double density disk controller for any combination of 5¼" and 8" single or double sided, analog phase-locked loop data seperator, vectored interrupts. CP/M 2.2 & Oasis compatible control/diagnostic software PROM included.

IOD-1160A	*A & T With Prom*	**$359.95**
SFC-55009047F	*CP/M 3.0 With VF-II*	**$139.95**

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High reliability double density disk controller with on-board Z-80A, auxilary printer port, IEEE S-100 can function in multi-user interrupt driven bus

IOD-1200B	*Bare board & hdwr man*	**$59.95**
IOD-1200K	*Kit w/hdwr & sftwr man*	**$299.95**
IOD-1200A	*A & T w/hdwr 7 sftwr man*	**$325.95**
SFC-59002001F	*CP/M 2.2 With Double D*	**$99.95**

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Two computers in one, Z-80 & 6502, more than doubles the power and potential of your Apple, includes Z-80 CPU card, CP/M 2.2 and complete manual set. Pascal compatible, utilities are menu-driven. One year warranty

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CIRCLE 185 ON READER SERVICE CARD

Sound Tables: Fast Sound Effects From Basic

Christopher Adams

Having survived a myriad of attacking space creatures, the sounds of dying aliens and exploding laser bases singing in my ears, I returned to Applesoft and resumed programming. Like many aspiring programmers, I dreamed of writing my own action-packed arcade games. But since the only language I knew was Basic, I knew I had a while to go.

Still, I had mastered shape tables and done some interesting graphics routines. Some of my programs could have been convincing except for one missing feature—sound. The best I could manage was a sickening buzz created by repeatedly POKEing -16336 or the familiar boring beep.

Then I discovered machine language. It was so easy to make sounds that I decided to write a small program that would enable virtually any sound effect to be executed through Basic.

You might have seen sound routines that enable you to select the tone and the duration for a single tone. These are fine for games, but they do have drawbacks. First of all they have a limited range of tones. Second, the higher notes have shorter durations. And most important, any string of tones is subject to pauses where Basic processes the next piece of data.

Wouldn't it be convenient I thought, if any complete sound could be executed with one command? My answer was Sound Table. It is similar to shape tables in that you must create a table of data, select the sound number, then execute it. The table can consist of as many as of 256 sounds, each consisting of up to 255 tones or pauses. A sound can be anything from a single note to an explosion to the

Listing 1.

```
0300-   A5 F9       LDA   $F9
0302-   0A          ASL
0303-   08          PHP
0304-   18          CLC
0305-   6D D6 03    ADC   $03D6
0308-   A8          TAY
0309-   8D 19 03    STA   $0319
030C-   A9 00       LDA   #$00
030E-   6D D7 03    ADC   $03D7
0311-   28          PLP
0312-   69 00       ADC   #$00
0314-   AA          TAX
0315-   8D 1A 03    STA   $031A
0318-   AD 00 90    LDA   $9000
031B-   C8          INY
031C-   D0 01       BNE   $031F
031E-   E8          INX
031F-   8C 27 03    STY   $0327
0322-   A8          TAY
0323-   8E 28 03    STX   $0328
*326L

0326-   AD 01 90    LDA   $9001
0329-   AA          TAX
032A-   98          TYA
032B-   8D 32 03    STA   $0332
032E-   8E 33 03    STX   $0333
0331-   AC 02 90    LDY   $9002
0334-   84 FB       STY   $FB
0336-   18          CLC
0337-   69 01       ADC   #$01
0339-   D0 01       BNE   $033C
033B-   E8          INX
033C-   8D 6D 03    STA   $036D
033F-   8E 6E 03    STX   $036E
0342-   18          CLC
0343-   8C 47 03    STY   $0347
0346-   69 01       ADC   #$01
0348-   90 01       BCC   $034B
034A-   E8          INX
034B-   8D 72 03    STA   $0372
034E-   8E 73 03    STX   $0373
*351L

0351-   18          CLC
0352-   8C 56 03    STY   $0356
0355-   69 01       ADC   #$01
0357-   90 01       BCC   $035A
0359-   E8          INX
035A-   8D 78 03    STA   $0378
035D-   8E 79 03    STX   $0379
0360-   20 64 03    JSR   $0364
0363-   60          RTS
0364-   A6 FB       LDX   $FB
0366-   86 FD       STX   $FD
0368-   A2 00       LDX   #$00
036A-   86 FA       STX   $FA
036C-   BD 03 90    LDA   $9003,X
036F-   85 FF       STA   $FF
0371-   BD 04 90    LDA   $9004,X
0374-   8D AA 03    STA   $03AA
0377-   BD 05 90    LDA   $9005,X
037A-   8D B1 03    STA   $03B1
037D-   20 92 03    JSR   $0392
*380L

0380-   A4 FD       LDY   $FD
0382-   88          DEY
0383-   F0 08       BEQ   $038D
0385-   A6 FA       LDX   $FA
0387-   E8          INX
0388-   84 FD       STY   $FD
038A-   4C 6A 03    JMP   $036A
038D-   60          RTS
038E-   A5 FE       LDA   $FE
0390-   85 FF       STA   $FF
0392-   AD AA 03    LDA   $03AA
0395-   F0 2B       BEQ   $03C2
0397-   A9 00       LDA   #$00
0399-   38          SEC
039A-   ED B1 03    SBC   $03B1
039D-   8D A8 03    STA   $03A8
03A0-   A6 FF       LDX   $FF
03A2-   CA          DEX
03A3-   F0 1C       BEQ   $03C1
03A5-   86 FF       STX   $FF
*3A7L

03A7-   A2 F0       LDX   #$F0
03A9-   A9 02       LDA   #$02
03AB-   38          SEC
03AC-   E9 01       SBC   #$01
03AE-   F0 08       BEQ   $03B8
03B0-   A0 10       LDY   #$10
03B2-   88          DEY
03B3-   D0 FD       BNE   $03B2
03B5-   4C AB 03    JMP   $03AB
03B8-   8D 30 C0    STA   $C030
03BB-   CA          DEX
03BC-   D0 EB       BNE   $03A9
03BE-   4C A0 03    JMP   $03A0
03C1-   60          RTS
03C2-   A6 FF       LDX   $FF
03C4-   CA          DEX
03C5-   F0 FA       BEQ   $03C1
03C7-   AC B1 03    LDY   $03B1
03CA-   88          DEY
03CB-   D0 FD       BNE   $03CA
*3CDL

03CD-   A0 FF       LDY   #$FF
03CF-   88          DEY
03D0-   D0 FD       BNE   $03CF
03D2-   4C C4 03    JMP   $03C4
```

Christopher Adams, 1864 Mathews, Vancouver, BC Canada V6J 2T6.

entire "Star Spangled Banner."

To use Sound Table, you must first POKE in the machine language routine in Listing 1 and then BSAVE it. From then on all that is required is to BLOAD it at the beginning of your program and put the table pointer in locations 982-983 (these are just like locations 232-233 for shape tables).

Once the machine language program and a sound table are in, memory location 249 is POKEd with the sound number to be used (the first sound being #0). When the Basic instruction call 768 is encountered, the sound table program executes the sound number currently in location 249.

Sound Table is very efficient, and is therefore useful in machine language programs so I have provided the assembler listing as well as the Basic listing to POKE it into memory.

Getting Started

To get Sound Table going, just type in the Basic program in Listing 2 and run it. The program has a simple error-checking routine. If everything is in order, the program will create a simple sound table, and if it works a beep will be emitted.

If it doesn't do this, check the data again.

After successfully running the program, type BSAVE SOUND TABLE,A$300, L$D5. This will create a machine language file on your disk that can be retrieved with BLOAD SOUND TABLE. If you don't have a disk drive, just POKE in all the data at the beginning of any program that uses Sound Table.

Listing 2. Sound Table.

```
1  CLEAR
10 A = 768
15  READ D: IF D > 255 THEN 150
16 DT = DT + D
20  POKE A,D:A = A + 1: GOTO 15
100  DATA  165,249,10,8,24,109,21
     4,3
101  DATA  168,141,25,3,169,0,109
     ,215
102  DATA  3,40,105,0,170,141,26,
     3
103  DATA  173,0,144,200,208,1,23
     2,140
104  DATA  39,3,168,142,40,3,173,
     1
105  DATA  144,170,152,141,50,3,1
     42,51
106  DATA  3,172,2,144,132,251,24
     ,105
107  DATA  1,208,1,232,141,109,3,
     142
108  DATA  110,3,24,140,71,3,105,
     1
109  DATA  144,1,232,141,114,3,14
     2,115
110  DATA  3,24,140,86,3,105,1,14
     4
111  DATA  1,232,141,120,3,142,12
     1,3
112  DATA  32,100,3,96,166,251,13
     4,253
113  DATA  162,0,134,250,189,3,14
     4,133
114  DATA  255,189,4,144,141,170,
     3,189
115  DATA  5,144,141,177,3,32,146
     ,3
116  DATA  164,253,136,240,8,166,
     250,232
117  DATA  132,253,76,106,3,96,16
     5,254
118  DATA  133,255,173,170,3,240,
     43,169
119  DATA  0,56,237,177,3,141,168
     ,3
120  DATA  166,255,202,240,28,134
     ,255,162
121  DATA  240,169,2,56,233,1,240
     ,8
122  DATA  160,16,136,208,253,76,
     171,3
123  DATA  141,48,192,202,208,235
     ,76,160
124  DATA  3,96,166,255,202,240,2
     50,172
125  DATA  177,3,136,208,253,160,
     255,136
126  DATA   208,253,76,196,3,300
150  IF DT <  > 25333 THEN  PRINT
     "I THINK YOU MADE A MISTAKE
     IN ENTERING THE DATA"
155  FOR A = 36864 TO 36869: READ
     D: POKE A,D: NEXT A: POKE 98
     2,0: POKE 983,144: POKE 249,
     0: CALL 768
160  DATA  2,144,1,3,2,100
```

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Sound Tables, continued...

Making A Table

You can either learn to make tables by hand or you can use the Soundmaker program (Listing 3) to simplify the process. The first thing you must know is what makes up a tone. Each tone consists of three pieces of data: duration (2-255), coarse tone (2-255), and fine tone (2-255). Notice that the parameters for all these are 2-255—a 2 for the duration causes a duration of one unit and a 2 for fine tone causes a frequency of one unit. In other words, the actual unit used = desired unit + 1.

Next we must distinguish between coarse tone and fine tone. As I mentioned earlier, one byte isn't sufficient to designate all the possible tones, so the frequency is derived from coarse tone times fine tone (CT-1 * FT-1). In this program the higher the tone (frequency) the lower the tone sounds. This is because Sound Table makes the tone by making a delay loop; the length is specified by the tone between clicks of the speaker.

Duration is a loop which specifies how many times the speaker is clicked. The longer the time between clicks (frequency), the longer the duration. Sound Table automatically counters this, but there will still be a slight stretching of duration for very low tones.

To create pauses between notes, make the coarse tone equal to zero (this is the one exception to the 2-255 parameter. In this case, the duration is still duration, but fine tone becomes fine duration. The duration of a pause is much shorter than that of a tone, so make the duration a high number.

Before getting into the table structure it would be best to familiarize yourself with Sound Table by using Soundmaker. Type in Soundmaker and run it. To give you an idea of what tone all these pieces of data create, use the following procedures to make a tone similar to the CTRL-G beep, using the data pieces CD-3, CT-3, FT-50.

The first question asked is where to put the table in memory. Since the table isn't relocatable as are shape tables, it is necessary to decide now. If you have a 48K Apple, the best place to put it is about 36864 ($9000 hex) setting himem to 36863.

Listing 3.

```
1  HOME : CLEAR : PRINT  CHR$ (4)
      + "BLOAD SOUND TABLE"
5  INPUT "WHERE IS THIS TABLE TO
     BE LOCATED ";ST:PS = ST
6 MS =  INT (ST / 256):LS = ST -
     (MS * 256): POKE 982,LS: POKE
     983,MS
10  INPUT "HOW MANY SOUNDS?";NS:S
     N = 1
11 PS = (NS * 2) + ST
20  HOME : PRINT "              C
     REATE MODE": PRINT "SOUND #"
     ;SN
25  INPUT "LENGTH OF THIS SOUND "
     ;L
26 MS =  INT (PS / 256):LS = PS -
     (MS * 256)
28  POKE (ST + ((SN - 1) * 2)),LS
     : POKE (ST + 1 + ((SN - 1) *
     2)),MS
30  POKE PS,L
35  FOR X = 1 TO L: INPUT "CD,CT,
     FT ";CD,CT,FT
40  POKE (PS + X),CD: POKE (PS +
     L + X),CT: POKE (PS + L + L +
     X),FT: NEXT
45  INPUT "DO YOU WANT TO HEAR IT
     ?";I$: IF  LEFT$ (I$,1) = "Y
     " THEN  POKE 249,(SN - 1): CALL
     768
50  HOME : PRINT "      1 :NEXT SO
     UND": PRINT "      2 :RE-CREA
     TE": PRINT "      3 :EDIT MOD
     E"
55  GET I$:I =  VAL (I$): ON I GOTO
     60,20,70: GOTO 55
60 SN = SN + 1: IF SN > NS THEN 2
     00
65 PS = PS + 1 + (3 * L): GOTO 20

70  HOME : PRINT "
       EDIT MODE": PRINT : PRINT
     "      1 :CHANGE ALL OF ONE
     TONE": PRINT "      2 :CHANG
     E ALL CD'S": PRINT "      3
     :CHANGE ALL CT'S": PRINT "
        4 :CHANGE ALL FT'S": PRINT
     "      5 :LISTEN":
72  PRINT "      6 :RETURN": POKE
     34,9
75  GET I$:I =  VAL (I$): ON I GOTO
     80,90,100,110,120,130 GOTO 7
     5
80  HOME : INPUT "WHICH TONE #";T
     N
82  PRINT "OLD VALUES---"; PEEK (
     PS + TN);"--"; PEEK (PS + L +
     TN);"--"; PEEK (PS + L + L +
     TN): INPUT "NEW CD,CT,FT ";C
     D,CT,FT
85  POKE (PS + TN),CD: POKE (PS +
     L + TN),CT: POKE (PS + L + L
      + TN),FT: HOME
87  GOTO 75
90  INPUT "WHAT DO YOU WANT TO AD
     D TO ALL THE CD'S (A NEGATIV
     E # WILL DECREMENT THEM) ";I

95  FOR X = (PS + 1) TO (PS + L):
       POKE X,( PEEK (X) + I): NEXT
     X: HOME : GOTO 75
100  INPUT "WHAT DO YOU WANT TO A
     DD TO ALL THE CT'S (A NEGATI
     VE # WILL DECREMENT THEM) ";
     I
105  FOR X = (PS + L + 1) TO (PS +
     L + L): POKE X,( PEEK (X) +
     I): NEXT X: HOME : GOTO 75
110  INPUT "WHAT DO YOU WANT TO A
     DD TO ALL THE FT'S (A NEGATI
     VE # WILL DECREMENT THEM) ";
     I
115  FOR X = (PS + L + L + 1) TO
     (PS + (3 * L)): POKE X,( PEEK
     (X) + I): NEXT X: HOME : GOTO
     75
120  POKE 249,(SN - 1): CALL 768:
      HOME : GOTO 75
130  POKE 34,0: HOME : GOTO 50
200  POKE 34,0: HOME : PRINT " TH
     E TABLE IS FINISHED!!!!!"
201 NS = NS
205 LE = (3 * L) + 1
210  PRINT : PRINT : PRINT : PRINT
     "STARTING AT ";ST: PRINT "LE
     NGTH ";LE
215  INPUT "WHAT DO YOU WANT TO N
     AME IT?";NAME$
220 S$ =  CHR$ (4) + "BSAVE " + N
     AME$ + ",A" +  STR$ (ST) + "
     ,L" +  STR$ (LE): PRINT S$
225  PRINT "WHEN USING THIS TABLE
      POKE 982,"; PEEK (982): PRINT
     "AND POKE 983,"; PEEK (983)
230  PRINT "POKE 249,(";0;" TO ";
     NS - 1;") TO SELECT THE SOUN
     D #": PRINT "THEN CALL 768":
      END
```

The next question is how many sounds you want in this table. This can be any number from 1 to 256. For this example enter 1. You will then enter the create mode. Choose a length of 1 for the number of tones and pauses in this sound. You will then get the prompt CD,CT,FT (duration, coarse tone, fine tone).

Enter 3,3,50. Try listening to it; it should sound like the CTRL-G beep. Next enter the editing mode. Fiddle around by changing the data. Adjusting all CD will increase the length of all the tones in the sound you are working on (in this case only one tone). A similar action is taken when CT and FT are adjusted. Be careful that adjustments do not push any of the data beyond the 2 to 255 limits.

When you have made your adjustments, return to the main menu and select option 2. Re-create the sound. This time choose a longer length and try different combinations of tones and pauses—you might even try writing a short tune. Once you have satisfied your curiosity choose Next Sound. The program will finish creating the table and ask you what you want to name it. Even if you don't want to keep this table give it a name anyway to see what comes next (you can delete it later). Soundmaker will give you all the

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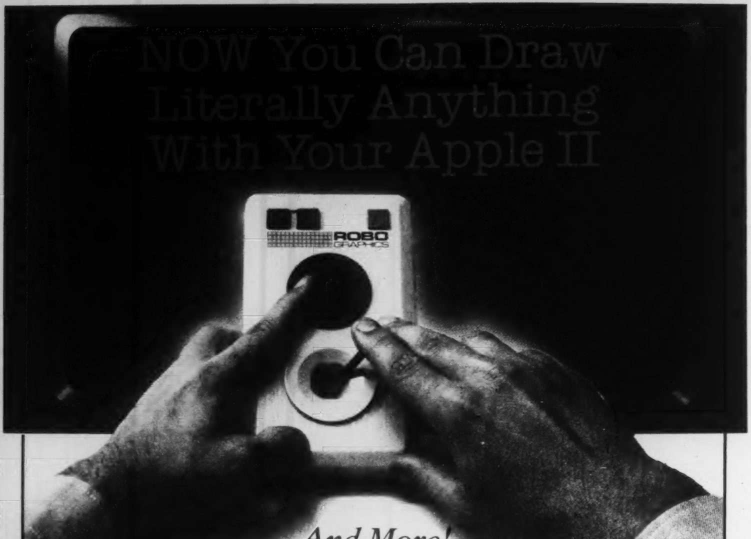

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Sound Tables, continued...

necessary information for using the shape table in your own program.

When using Sound Table you must always load the program itself and an actual table and POKE in the table pointers at locations 982 and 983 (Soundmaker will tell you what values to use).

Table Structure

The first section of the table holds the sound pointers. The first two bytes are the absolute address of sound 1 (remember that if location 249 equals 0, then sound 1 is executed; if it equals 1 then sound 2 is executed). The next two bytes point to sound 2 and so on. Note that there is no place to designate the number of sounds in the table, so an attempt to execute a non-existent sound will cause random effects.

The absolute address goes in the order of least significant byte followed by the most significant byte. To find the decimal equivalent MSB=int (address/256) and LSB=address-(MSB*256).

The data tables for the sounds do not have to appear in any sort of order. The datafield for each sound starts with a byte specifying the number of tones in the sound (for this discussion this byte will become the variable L).

The next L number of bytes contain all the durations. That is, the first byte after L is the duration for the first tone, the second byte is the duration of the second tone, and so on. Immediately after the last duration byte comes the first coarse tone byte, followed by the CT for the second tone. After the last coarse tone byte comes the first fine tone byte, followed by the second, etc.

Table 1 details the components of the tone CD-3,CT-2,FT-70 followed by tone CD-2,CT-3,FT-100. The table starts at 36864. If there were two sounds the pointer for the second sound would have been at 36866 and sound 1 would have started at 36868.

Table 1.

36864:	2	144	points to sound 1
36866:	2		length of sound 1
36867:	3		duration of tone 1
36868:	2		duration of tone 2
36869:	2		coarse tone of 1
36870:	3		coarse tone of 2
36871:	70		fine tone of 1
36872:	100		fine tone of 2

Summary

Now that Sound Table is up and running, you can create a table with 256 sounds each of which can have 255 parts. The sound number can be selected by POKEing 249 and executed by call 768. The program is located starting at 768 ($300 hex), and the actual table is pointed to by locations 982-983(LSB-MSB). ☐

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The Well-Tempered Apple

Michael Fink

Games and other programs have made Apple users aware of the Apple speaker as a source of music and sound effects. Nearly every guide to Apple programming gives the memory address (49200, -16336, or $C030) at which you can PEEK and "tweak" the speaker. Some sources list a machine language routine which enables you, by supplying one value (1-255) for frequency and another (1-255) for duration, to produce a pitch through the speaker. CALLing such a routine several times in succession, each time supplying new frequency and duration values, results in a sequence of tones, a melody.

Problem: Tuning And Range

This is all well and good for fun-and-games programming. But for genuine musical applications—or better quality recreational software—those routines have serious limitations in tuning accuracy and range (low bass to high treble) because of the limited range of frequency values.

If you try various values in one of those machine language routines, you will have no trouble going high in the range, but the lowest pitch you can access, unfortunately, is somewhere around g_1. That is certainly not an acceptable lower limit for even the simplest melody.

However, the root of the problem lies not so much in the limited numeric values as in the high operating speed of the machine language routine. The routine, as it stands, simply pushes the speaker in and out at a frequency which cannot be adjusted below a defined limit. Clearly, what is needed is a way of *delaying* each tweak of the speaker, of slowing down the routine in a controlled manner, so that the bottom limit can be lowered significantly through program control. As will be seen, solving the range problem also solves the pitch accuracy problem.

What is needed is a way of delaying each tweak of the speaker.

Solution: A Delay Factor

The following routine produces a pitch somewhere around f:

```
10 X= -16336
20 S= PEEK(X) : GOTO 20
```

But it is probably the highest pitch available by operating the speaker purely from Basic. Because of the inherent slowness of working through the Basic interpreter, there is a built-in delay between one tweak of the speaker and the next.

The delay may be lengthened by adding program lines or delaying loops, and the result will be a lowered pitch. But there is no way of raising the pitch, since the built-in delay in the operation of the Basic interpreter cannot be reduced. Thus, music in a Basic program has a severe *upper* pitch limit problem due to its inherent slowness, and music in a machine language program has an equally severe *lower* pitch limit due to its inherent higher speed.

By applying the principle of delay illustrated above to machine language routines, I arrived at the solution to both the range and tuning problems of the Apple speaker. I employed a fairly common machine language routine (Listing 1) that uses X and Y registers for work

Listing 1. Machine language routine, including delay factor, for sounding pitches.

```
0300-   00          BRK
0301-   00          BRK
0302-   00          BRK
0303-   AC 01 03    LDY   $0301
0306-   AE 01 03    LDX   $0301
0309-   AD 02 03    LDA   $0302
030C-   20 A8 FC    JSR   $FCA8
030F-   AD 30 C0    LDA   $C030
0312-   E8          INX
0313-   D0 FD       BNE   $0312
0315-   88          DEY
0316-   D0 EE       BNE   $0306
0318-   CE 00 03    DEC   $0300
031B-   D0 E6       BNE   $0303
031D-   60          RTS
```

Michael Fink, 4826 Bucknell, San Antonio, TX 78249.

with a frequency value (POKEd into $0301) and a decrementing duration value (POKEd into $0300). However, I added a third value, the *delay factor*, and POKEd it into $0302 for control within the subroutine itself, which begins at $0303.

The value of the delay factor (1-255) is loaded into the accumulator at $0309. Then, at $030C a resident subroutine, JSR $FCA8, is executed. Using the value currently in the accumulator, this subroutine causes the machine language routine to WAIT a specified length of time. (For L = delay factor value, the delay will equal $.5(26+27L+5L^2)$ microseconds, and the accumulator will be zeroed at the end.)

This is the crux of the whole operation, and its implications are twofold. 1) Using large delay factor values makes it possible to lower pitch all the way down to about 1 Hz. 2) It is now possible to arrive at an accurately tuned, equal tempered scale. By increasing or decreasing the delay factor value, the pitch can be lowered or raised by a significant degree. That is, with the frequency value constant, incrementing or decrementing the delay factor changes the pitch by about a half-step. This leaves the frequency value free to "fine tune" the desired pitch.

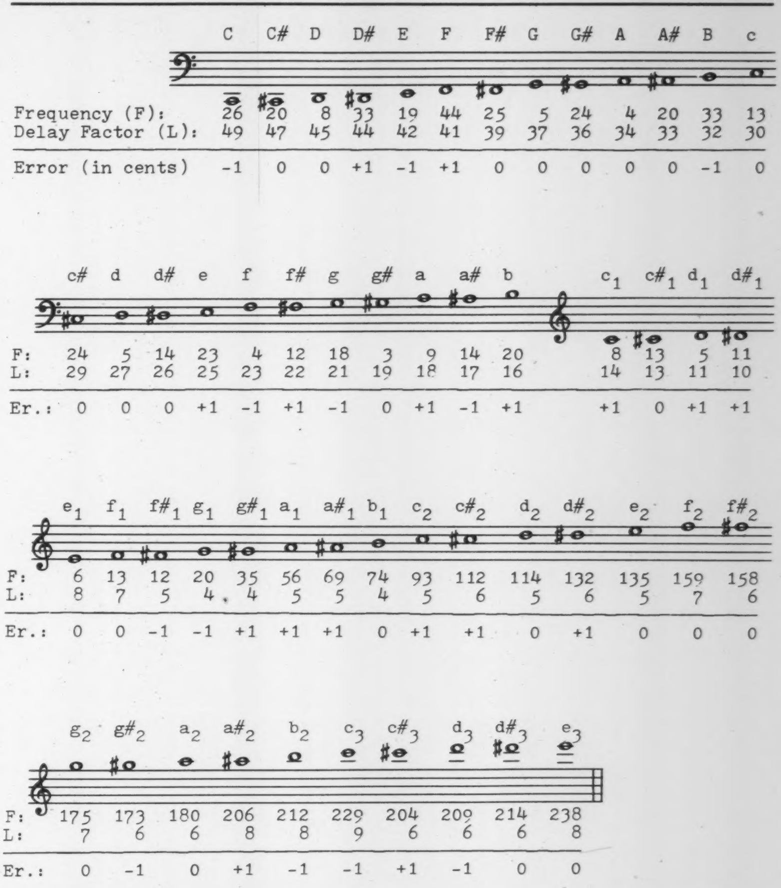
Tuning The Apple

Using the machine language routine and principles mentioned above, I have arrived at numeric values for a wide range, equal tempered chromatic scale extending from C to e_3 (see Figure 1). Each pitch is accurate to ±1 cent (1% of the distance to the next higher or lower equal tempered pitch). That degree of difference is not apparent to the human ear.

If you wish, you can extend the scale even further in either direction, but you will need to use some sort of tuning device. I used a Korg Chromatic Tuner (model WT-12) and placed it near or against the left side of the Apple where the microphone could pick up the speaker easily and the meter could also be read. Using the Korg, I tested the pitch on four different Apples to make sure that the clock rate of the processor would be consistent among various computers. Accuracy was within .5 cents.

Playing The Apple

Accessing pitch from a Basic program using the machine language routine is not difficult. Two things are necessary: a subroutine that will POKE the three values into memory and CALL the machine language routine that drives the speaker, and a method for assigning values to the three variables for each note.



	C	C#	D	D#	E	F	F#	G	G#	A	A#	B	c
Frequency (F):	26	20	8	33	19	44	25	5	24	4	20	33	13
Delay Factor (L):	49	47	45	44	42	41	39	37	36	34	33	32	30
Error (in cents)	-1	0	0	+1	-1	+1	0	0	0	0	0	-1	0

	c#	d	d#	e	f	f#	g	g#	a	a#	b	c_1	$c\#_1$	d_1	$d\#_1$
F:	24	5	14	23	4	12	18	3	9	14	20	8	13	5	11
L:	29	27	26	25	23	22	21	19	18	17	16	14	13	11	10
Er.:	0	0	0	+1	-1	+1	-1	0	+1	-1	+1	+1	0	+1	+1

	e_1	f_1	$f\#_1$	g_1	$g\#_1$	a_1	$a\#_1$	b_1	c_2	$c\#_2$	d_2	$d\#_2$	e_2	f_2	$f\#_2$
F:	6	13	12	20	35	56	69	74	93	112	114	132	135	159	158
L:	8	7	5	4	4	5	5	4	5	6	5	6	5	7	6
Er.:	0	0	-1	-1	+1	+1	+1	0	+1	+1	0	+1	0	0	0

	g_2	$g\#_2$	a_2	$a\#_2$	b_2	c_3	$c\#_3$	d_3	$d\#_3$	e_3
F:	175	173	180	206	212	229	204	209	214	238
L:	7	6	6	8	8	9	6	6	6	8
Er.:	0	-1	0	+1	-1	-1	+1	-1	0	0

Figure 1. Table of values for a four-octave chromatic scale.

Accessing pitch from a Basic program using the machine language routine is not difficult.

The speaker driver subroutine can be quite simple:

```
10 REM SPEAKER DRIVER
20 POKE 769, F
30 POKE 770, L
40 POKE 768, D
50 CALL 771
60 RETURN
```

For storing variable values, I suggest creating an array of data to be read into the program with one DATA line for each sound. The array can be set up to be used either sequentially or by random access. If arranged sequentially, as in a melody, values are assigned to F (frequency), L (delay factor), and D (duration) for each of N notes:

```
 500 FOR I=1 TO N
 501 READ F(I), L(I), D(I)
 502 NEXT I
1000 REM THREE BLIND MICE
1001 DATA 6,8,50
1002 DATA 5,11,60
1003 DATA 8,14,45
```

If several melodies are required in a program, random access may be more desirable. In that case, the array is made up of the entire, full-range scale of N notes that may be needed, but only F and L values are read in at first:

```
 500 FOR I=1 TO N
 501 READ F(I), L(I)
 502 NEXT I
1000 REM E-MAJOR SCALE
1001 DATA 23,25
1002 DATA 12,22
1003 DATA 3,19
```

Here, the D value for a given note is assigned only when the speaker driver subroutine is CALLed for that note.

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Apple Speaker, continued...

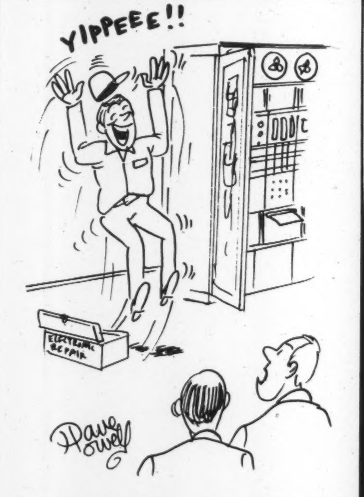
The Rhythm Trade-Off

My method of making music through the Apple speaker is three-dimensional, and there are always trade-offs when juggling three dimensions. The trade-off here is one of frequency/delay vs. duration, and the challenge is to maximize tuning accuracy while maintaining as much flexibility as possible in duration or rhythm. Long notes are no problem, but the programmer should be able to sound a pitch for a very short duration, as well. The brevity of any note in my system is dependent somewhat on the value of the delay factor. That is why each pitch in Figure 1 is assigned the *lowest* possible delay factor consistent with close tuning.

Since pitch and duration are so interdependent in any program using the Apple speaker, there is no reliable ratio between duration values. For a given duration (say, either a quarter note or 0.5 second) one pitch will require one value and another pitch will require something quite different. Therefore, duration values must be assembled by experimentation.

Conclusion

Although synthesizer cards and complete music systems offer more expensive and more sophisticated means of making music with an Apple, there are still many applications to be explored using immediately accessible sound through the speaker. With accurate and full-range pitch, the speaker possesses more of the capabilities of a real synthesizer, and by relatively simple means games and educational programs can include music that actually sounds like music.☐



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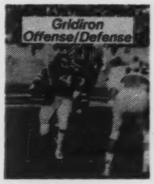
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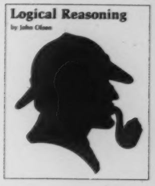
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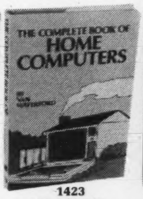
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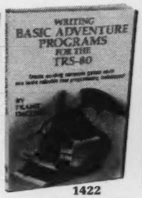
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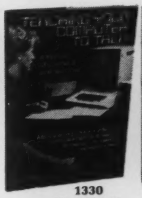

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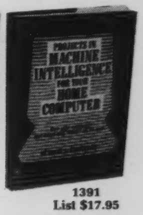
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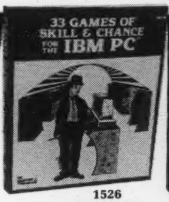
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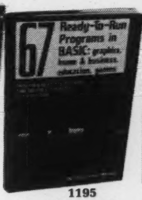
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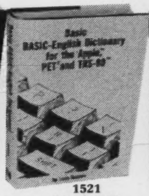
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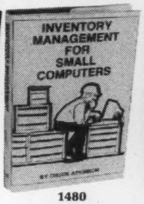
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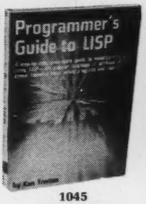
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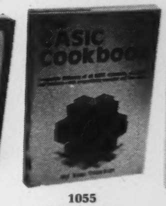
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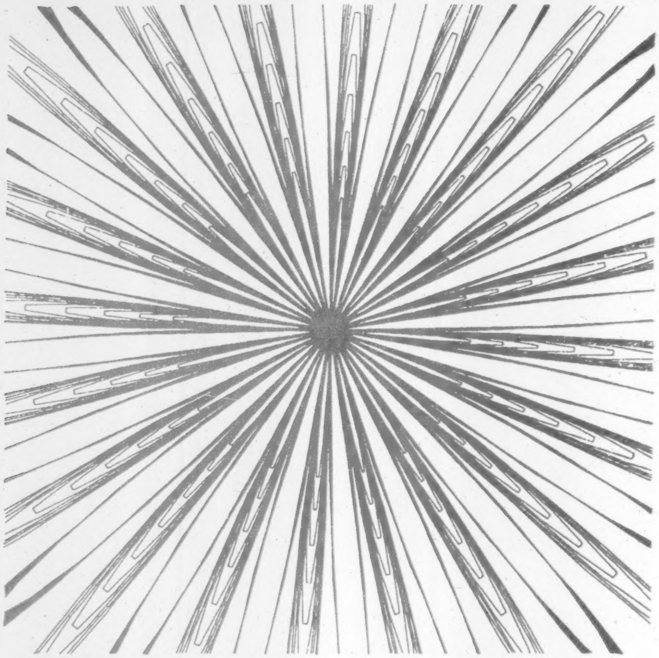
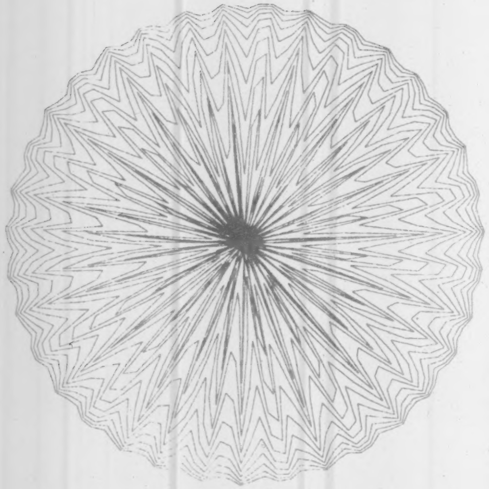
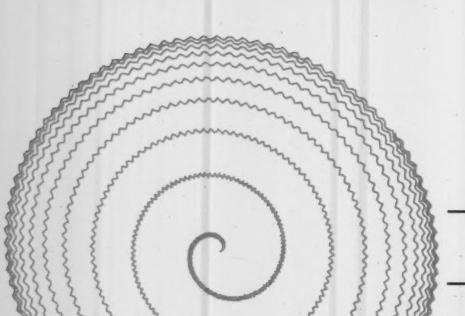




Computer Art For The Tektronix 4052

```
100 REM WOBBLY SPIRAL
110 PAGE
120 WINDOW -1.1,1.1,-1.1,1.1
130 Q=0
140 SET DEGREES
150 PRINT " ENTER 1 FOR SINGLE LAYER, OR 2 FOR OVERLAY."
160 INPUT P
170 PRINT "ENTER L"
180 INPUT L
190 PRINT "ENTER G"
200 INPUT G
210 PRINT "ENTER E"
220 INPUT E
230 PRINT "ENTER K"
240 INPUT K
250 PRINT "ENTER C"
260 INPUT C
270 GO TO 470
280 FOR A=0 TO 3600 STEP G
290 B=E+C*EXP(-L*A)
300 R=1-EXP(-L*A)+-1↑(M-1)*B*SIN(K*A)
310 X=R*COS(A)
320 Y=R*SIN(A)
330 IF T1=2 THEN 360
340 VIEWPORT 30,100,30,100
350 GO TO 370
360 VIEWPORT 15,115,0,100
370 IF ABS(A)>0 THEN 400
```



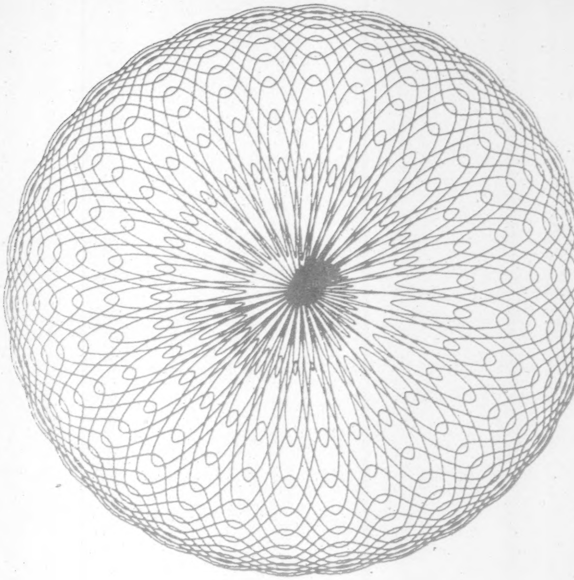
Joe Jacobson

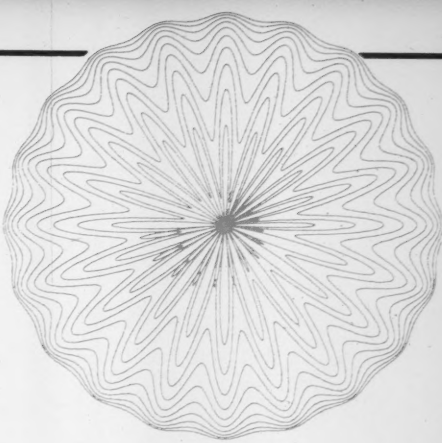
This month I will describe a polar coordinate program that is completely different from those I have presented in past issues of *Creative Computing*. This is the Wobbly Spiral program. The name follows directly from the algorithm.

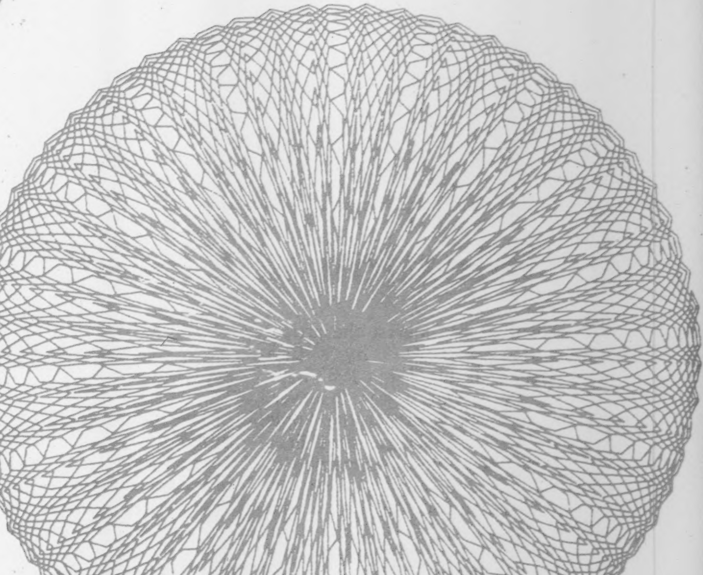
The program draws an exponential spiral that has a sine wave superimposed on it. The "tightness" of the spiral is controlled by the parameter L. The amplitude and frequency of the sine wave are controlled by the parameters C, E, and K. All these constants are entered from the keyboard, following user prompts.

The sine wave amplitude has a constant component (E) and a component

Joe Jacobson, 675 E. Street Road, Apt. 1009, Warminster, PA 18974.







```
380 MOVE X,Y
390 GO TO 410
400 DRAW X,Y
410 NEXT A
420 Q=Q+1
430 IF P=1 THEN 520
440 IF Q=2 THEN 520
450 M=2
460 GO TO 280
470 PRINT "ENTER T1.  T1 MUST BE 1 OR 2."
480 INPUT T1
490 PAGE
500 M=1
510 GO TO 280
520 IF T1=2 THEN 650
530 WINDOW 0,130,0,100
540 VIEWPORT 0,130,0,100
550 MOVE 0,20
560 PRINT "        WOBBLY SPIRAL PROGRAM PARAMETERS"
570 MOVE 0,10
580 PRINT "(P,L,G,E,K,C) = (";
590 PRINT P;",";L;",";G;",";E;",";K;",";C;")"
600 INPUT J$
610 T1=2
620 Q=0
630 WINDOW -1.1,1.1,-1.1,1.1
640 GO TO 490
650 END
```

(C) that decays exponentially with angle. (If you want the wobble to be the same size everywhere along the spiral, set C equal to 0. Otherwise, the wobble will decrease in size from the center of the spiral to the outer edge.) The parameter G is the angular increment used in computing the curve.

If you set T1 = 1, you will get a plot of the wobbly spiral with a list of input parameter values at the bottom of the picture. If you like the picture, make a hardcopy print for future reference. Then clear the screen and hit RETURN and you will get a "clean" plot (without the parameter list) of the same picture. Then you can make a hardcopy to show your friends. If you don't want a parameter value list at all, enter 2 after the prompt to enter T1.

If you want an overlay, yielding intertwining sine waves along the spiral, set P equal to 2. Otherwise, use P = 1. Table 1 lists suggested ranges of values for all of the input parameters. □

Table 1. Suggested Parameter Values.

Parameter	Range of Values	
	From	To
P*	1	2
L	0.001	0.002
G	0.5	3
E	0	0.4
K	5	20
C	0	0.4
T1*	1	2

*P and T1 must each be either 1 or 2.

ms...short programs... sho

Modification of Celestial Music

Bob Perkins

I read with great interest the article "Celestial Music" by Leo Christopherson in the March 1982 issue of *Creative Computing*. I was, however, unhappy that in his approach the Apple was incapable of producing musical lines of more than 120 notes. His method of packing a machine language program into a DATA statement is interesting, but restrictive.

I recoded the machine language portion, and have presented the source code here (as Listing 1) for others with assemblers. It is only two bytes longer than Christopherson's original, but will now accept any length of musical line.

Mr. Christopherson also asserted that while Atari users could utilize all free memory for their music programs. Apple users could not. By using the pointers at 109-110 ($6D-$6E) this program enables all free memory.

There is a hitch, however. All variables, including string variables, must be defined previously. The definitions themselves are irrelevant, but all pointers must be set up and space allocated beforehand. In this program I have set aside space for an array, which allows musical data to be entered in the form of a FOR-NEXT loop as opposed to a DATA statement. Bear in mind that all variables, including string variables, must be defined *before* the data are POKEd into memory.

Bob Perkins, Box 116, Tussy, OK 73088.

The routine can be CALLed from two different locations: the first, at 768, will automatically set the pointers to the end of the variable table. The second, at 776, allows the user to use any point in memory as a starting point for the data set. This allows storing of multiple songs back to back if the user keeps track of their starting locations in memory.

Listing 2 is a Basic program which converts alphabetical musical notation burden themselves with cryptic numerical key codes. I found that entering durations was more effective if left as numerical data, and not converted to whole, half, quarter, and so on. The slight delay coming to and from the data fetch leaves an audible pause, so though a whole and half note might have a duration of 16+8, a single note of duration 24 is more accurate.

The Applesoft program appears in somewhat ragged shape in order to have as much correlation as possible between the modification presented here and Christopherson's original program. More music could have been added very easily, as could better program flow. So get to work! ☐

Listing 1.

```
:ASM

                        1000 *CELESTIAL MUSIC SUBROUTINE
                        1010 *  BY LEO CHRISTOPHERSON
                        1020 *  CREATIVE COMPUTING MAR/82
                        1030 *  MOD. BY BOB PERKINS
                        1040 *-------------------------------
0064-                   1050 REST      .EQ $64
                        1060 * END.NUM IS THE APPLESOFT PNTR
                        1070 * TO THE END OF NUMERIC STORAGE
006D-                   1080 END.NUM   .EQ $6D,6E
00FA-                   1090 PNTR      .EQ $FA,FB   POINTER TO
                        1100 *                    DATA IN MEMORY
00FC-                   1110 DURATION .EQ $FC
00FD-                   1120 PITCH     .EQ $FD
00FE-                   1130 BEAT1     .EQ $FE
00FF-                   1140 BEAT2     .EQ $FF
00FF-                   1150 END.DATA .EQ $FF
C030-                   1160 SPKR      .EQ $C030
                        1170 *-------------------------------
                        1180         .OR $300
                        1190 *-------------------------------
```

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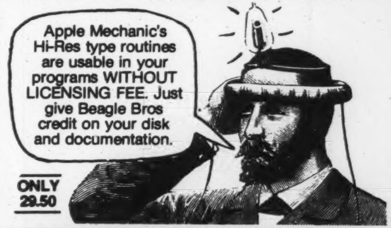
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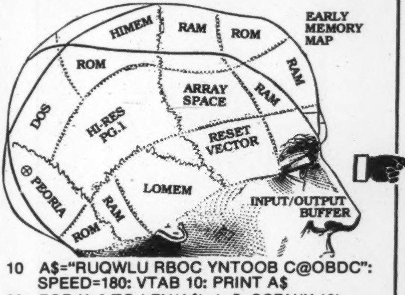

```
10   A$="RUQWLU RBOC YNTOOB C@OBDC":
     SPEED=180: VTAB 10: PRINT A$
20   FOR X=0 TO LEN(A$)-1: S=SCRN(X,19):
     COLOR=S+(S=12)-(S=13)-(SCRN(X,18)>10):
     PLOT X,19: NEXT X: GOTO 10
```

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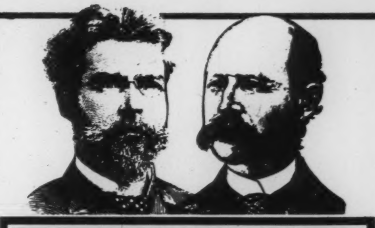

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Listing 1, continued.

```
0300- A5 6D     1200 START  LDA END.NUM    GET END OF
0302- 85 FA     1210        STA PNTR   NUMERIC STORAGE
0304- A5 6E     1220        LDA END.NUM+1  POINTER FOR
0306- 85 FB     1230        STA PNTR+1   OUR ROUTINE
                1240 *
                1250 GET.DATA
0308- A0 00     1260        LDY #$00
030A- B1 FA     1270        LDA (PNTR),Y
030C- C9 FF     1280        CMP #END.DATA
030E- D0 07     1290        BNE CELESTE  MAY EXIT
                1300 *
                1310 BUMP.PNTR
0310- E6 FA     1320        INC PNTR   THRU BUMP.PNTR
0312- D0 02     1330        BNE .1      IF END OF DATA
0314- E6 FB     1340        INC PNTR+1  IS ENCOUNTERED
0316- 60        1350 .1     RTS
                1360 *------------------------------
                1370 CELESTE
0317- 85 FC     1380        STA DURATION
0319- 20 10 03  1390        JSR BUMP.PNTR    GET PITCH
031C- B1 FA     1400        LDA (PNTR),Y
031E- 85 FD     1410        STA PITCH
0320- 20 10 03  1420        JSR BUMP.PNTR    NEXT DURATION
0323- A6 FD     1430        LDX PITCH
0325- A4 FD     1440        LDY PITCH
                1450 *
0327- A9 20     1460 PLAY   LDA #$20         INITIALIZE
0329- 85 FE     1470        STA BEAT1     TIMING LOOPS
032B- A9 FF     1480 .1     LDA #$FF        TO PRODUCE
032D- 85 FF     1490        STA BEAT2    DELAY IN TONE
032F- CA        1500 .2     DEX         WAIT (PITCH) CYCLES BEFORE BEEP
0330- D0 0B     1510        BNE .4
0332- A5 FD     1520        LDA PITCH
0334- C9 64     1530        CMP #REST    IF REST SKIP
0336- F0 03     1540        BEQ .3       SPKR TOGGLE
0338- AD 30 C0  1550        LDA SPKR
033B- A6 FD     1560 .3     LDX PITCH
033D- 88        1570 .4     DEY         WAIT (PITCH) CYCLES HERE TOO
033E- D0 0C     1580        BNE .6
0340- A5 FD     1590        LDA PITCH
0342- C9 64     1600        CMP #REST    IF REST SKIP
0344- F0 03     1610        BEQ .5       SPKR TOGGLE
0346- AD 30 C0  1620        LDA SPKR
0349- A4 FD     1630 .5     LDY PITCH
034B- 88        1640        DEY
                1650 * THE GRADUAL SHORTENING OF THE
                1660 * BEAT DELAYS ACCOUNTS FOR
                1670 * MOST IF NOT ALL OF THE
                1680 * BEATING EFFECT HEARD IN THIS
                1690 * ROUTINE. BEAT2 IS RENEWED EVERY
                1700 * TIME BEAT1 IS DECREMENTED.
034C- C6 FF     1710 .6     DEC BEAT2
034E- D0 DF     1720        BNE .2
0350- C6 FE     1730        DEC BEAT1
0352- D0 D7     1740        BNE .1
0354- C6 FC     1750        DEC DURATION   UNTIL TIME
0356- D0 CF     1760        BNE PLAY      IS UP THEN
0358- F0 AE     1770        BEQ GET.DATA   ALWAYS...


SYMBOL TABLE

00FE- BEAT1
00FF- BEAT2
0310- BUMP.PNTR
.01=0316
0317- CELESTE
00FC- DURATION
00FF- END.DATA
006D- END.NUM
0308- GET.DATA
00FD- PITCH
0327- PLAY
.01=032B, .02=032F, .03=033B, .04=033D
.05=0349, .06=034C
00FA- PNTR
0064- REST
C030- SPKR
0300- START
```

CALL 768
comes here.

CALL 776
comes here.

Listing 2.

```
10  REM  MUSIC ROUTINE MAY BE
      CALLED IN TWO WAYS. EITHER
      WITH DATA AT THE END OF THE
      VARIABLE TABLES OR AT ANY
      FREE SPOT IN MEMORY
20  REM CALL 768 FOR TABLE END
       OR 776 FOR USER DEFINED
       LOCATION
30  REM -----------------------
40  HOME : VTAB 12: HTAB 10: PRINT
      "CELESTE MUSIC DEMO": PRINT
      CHR$ (4);"BLOAD B.CELESTE"
50  GOSUB 250: REM      THIS USES
      END OF VAR TABLE
60  FOR N = 0 TO 52: READ D: POKE
     A0 + N,D: NEXT N:I = A0 + N
70  REM ----------------------
80  FOR N = 0 TO 52: READ D: POKE
     I + N,D: NEXT N
90  CALL 768: REM  FIRST DATA
100  POKE 250,(I / 256 -  INT (I /
     256)) * 256: POKE 251, INT (
     I / 256)
110  CALL 776: REM  THIS USES END
      OF FIRST DATA  AS A LOCATIO
     N FOR THE DATA
120  REM -----------------------
130  END
140  REM   DATA CAN NOW BE ANY
           REALISTIC LENGTH
150  DATA  16,215,16,107,8,113,4,
     143,4,127,8,113,6,107,2
160  DATA      100,16,215,16,127,2
     4,143,8,100,16,254,16,161,8,
     171
170  DATA     4,215,4,192,8,171,6,
     161,2,100,8,192,4,229
180  DATA     2,215,8,192,8,171,32
     ,215,255
190  DATA  8,215,8,107,4,113,2,14
     3,2,127,4,113,3,107,1
200  DATA     100,8,215,8,127,12,1
     43,4,100,8,254,8,161,4,171
210  DATA   2,215,2,192,4,171,3,1
     61,1,100,4,192,2,229
220  DATA  2,215,4,192,4,171,16,2
     15,255
230  REM -----------------------

240  REM   DECLARE ANY VARIABLES
      TO BE USED BETWEEN HERE AND
         CALL TO MUSIC ROUTINE
250 I = 0:N = 0:D = 0:A1 = 0:A2 =
    0:A0 = 0:A1 =  PEEK (109):A2
     =  PEEK (110):A0 = A1 + (A2
     * 256)
260  RETURN
```

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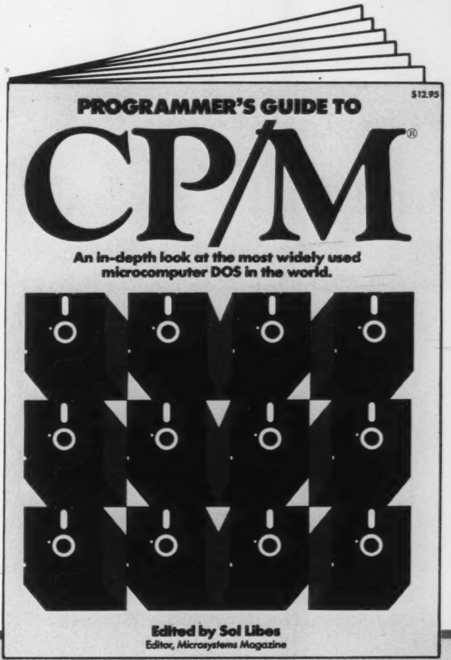
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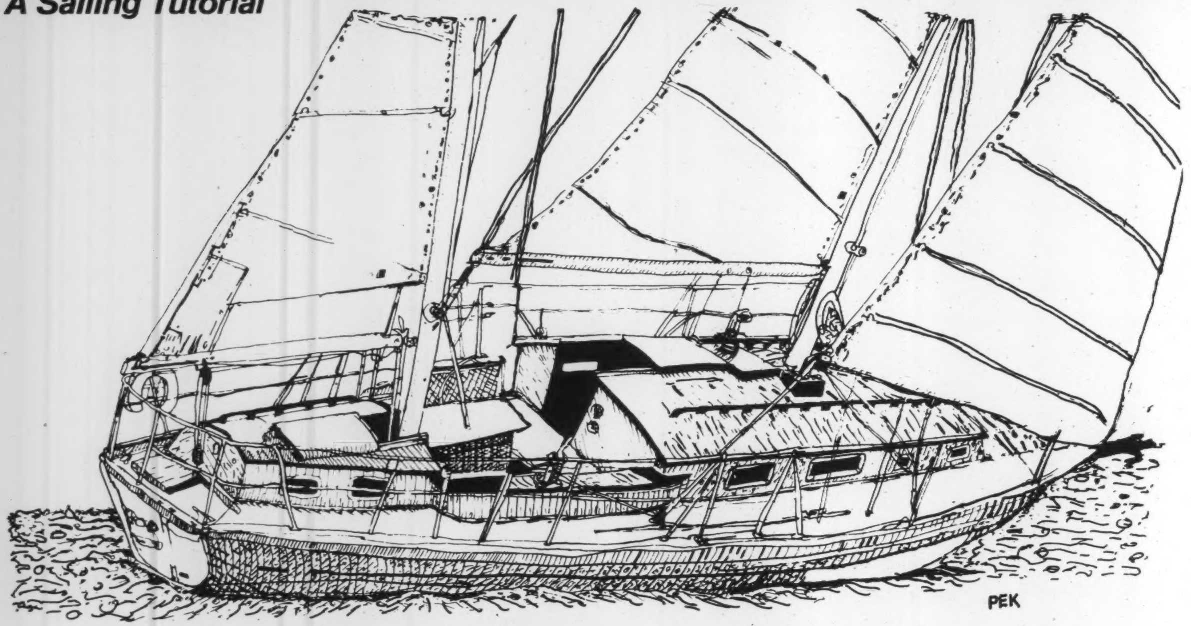


Animated Hi-Res Sailboat

Twenty years ago I invested three months and about four hundred dollars in my first sailboat. Then, armed with a copy of *The Penguin Book of Sailing* by Peter Heaton, I set forth in my homemade Windmill class sloop to investigate just what does happen when the wind is abaft the beam with the boom athwartships and the vang is slackened off. (As soon as I could find out what a vang was.)

Now, face wizened by the sun and salt spray, sitting in front of my Apple, the old lore in the Heaton book percolates upward from some long dormant recesses of my brain. I think back across the span of years to the vector diagrams in the opening chapters and wonder if I can implement them on my screen.

In approximately the same length of time as it took twenty years ago, I built my second homemade sailboat.

I remember wondering why it took so long the first time also.

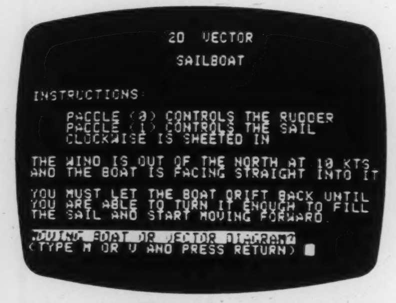
The program was conceived as a sailing tutorial that produces an animated vector diagram to illustrate the forces acting on a sailboat in motion. Somewhere along the way, I decided it would be nice to be able to sail a boat around the screen. After all, it's more fun to sail than to read a book about it and you can learn more by doing (or simulating) than by trying to understand someone else's vector diagrams.

Peter Schug

Thus was born the idea of a two-dimensional animated graphic hi-res simulation of a displacement hull with a trimmable sail and steerable rudder.

The program runs in either a moving boat mode, or a vector diagram mode. The choice is given at the beginning, but M or V can be pressed at any time to toggle the display. It makes sense to use the moving boat mode to start, then set up a situation (like beating to windward, running, setting the sails too tightly, etc.) then toggle to the vector mode and look at the operating forces.

Run the program and the boat will be drawn facing into the wind (10 kts coming out of the north). After a couple of cycles the boat will start drifting back slowly (as in leaving a mooring) and if you put the tiller hard over (paddle 0) the boat will start turning broadside to the wind. The sail is controlled by paddle 1 and should be fully until the boat has turned about 60° counterclockwise from the wind. Then sheet in the sail (paddle 1 clockwise) and straighten out the rudder. Since the screen updates are rather slow, make the adjustments and wait a couple of cycles to see their effect or you may tend to over-control.



```
              2D  VECTOR
               SAILBOAT

INSTRUCTIONS:

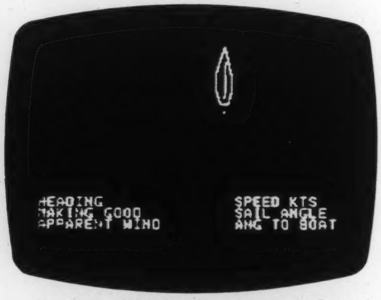
    PADDLE (0) CONTROLS THE RUDDER
    PADDLE (1) CONTROLS THE SAIL
    CLOCKWISE IS SHEETED IN

THE WIND IS OUT OF THE NORTH AT 10 KTS
AND THE BOAT IS FACING STRAIGHT INTO IT

YOU MUST LET THE BOAT DRIFT BACK UNTIL
YOU ARE ABLE TO TURN IT ENOUGH TO FILL
THE SAIL AND START MOVING FORWARD.

MOVING BOAT OR VECTOR DIAGRAM?
(TYPE M OR V AND PRESS RETURN)
```

Photo 1. This title page greets you when the program is run.



```
HEADING                  SPEED KTS
MAKING GOOD              SAIL ANGLE
APPARENT WIND            ANG TO BOAT
```

Photo 2. This is the opening frame, with the boat stationary and facing into a 10-knot wind. The screen legend titles are in place but no values have been written in.

Peter Schug, 1356 Odell St., Bronx, NY 10462.

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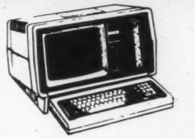

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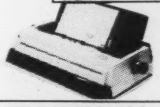

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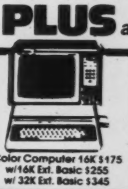

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CIRCLE 145 ON READER SERVICE CARD

On the bottom of the screen you will see a legend that bears these titles each followed by a number.

HEADING
MAKING GOOD
SPEED KTS
SAIL ANGLE
APPARENT WIND
ANGLE TO BOAT

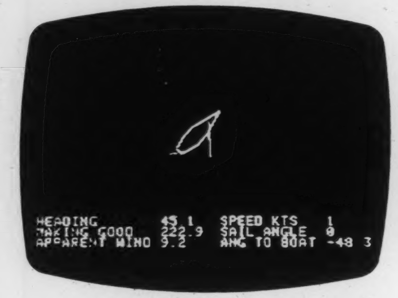
They translate as follows:

HEADING is the direction the boat is pointed.

SPEED KTS tells how fast the boat is going.

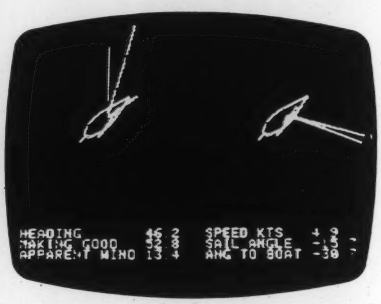
MAKING GOOD is the direction the boat is actually moving. Sailboats go a little sideways due to the force of the wind. The sideways motion is called leeway. The course made good includes leeway, therefore is not the same as the heading.

SAIL ANGLE is the angle at which the wind hits the sail. Positive numbers indicate starboard tack (meaning the wind is coming over the right side of the boat) and negative indicate port (wind coming over left side). The range is 0° to 180°. Specifically, it is not the sail freedom nor is it the angle of the sail to the boat.



```
HEADING         45.1  SPEED KTS    1
MAKING GOOD    222.9  SAIL ANGLE   0
APPARENT WIND  9.2    ANG TO BOAT -48 3
```

Photo 3. About five frames from the start. The sail is luffing (sail angle = 0) and the boat is backing up. (Notice the course made good vs. the heading.) If the rudder is centered and the sail is sheeted in, the boat will start moving to windward.



```
HEADING        46.2   SPEED KTS    4.9
MAKING GOOD    52.8   SAIL ANGLE  -15
APPARENT WIND  13.4   ANG TO BOAT -38
```

Photo 4. A couple of frames after the start, sailing to windward in vector diagram mode. The left boat shows the real wind (the vertical line), the boat motion vector (the one furthest from vertical), and the apparent wind, which is the remaining line. The right boat shows the lift vector, which is the upper of the two long lines on the right; the drag vector, which is somewhat obscured by the sail but still discernible, pointing SSW from the center of the boat, and the total force vector, just below the lift vector. The driving force applied to the hull is the forward component of the total force, and the lateral component divided by 20 is the leeway.

APPARENT WIND is the strength of the wind as it is felt on the boat. The vector sum of the forward motion of the boat and the speed of the wind add up to a strength and direction that is not the same as the real wind. Ask someone who has been sailing downwind with a large genoa on a breezy day, then turned around and tried to beat to windward.

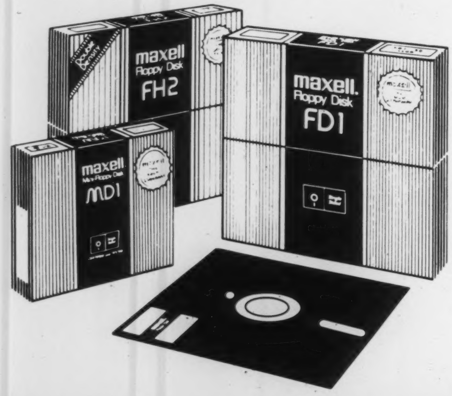
You can get a fair idea of how a boat sails.

ANG TO BOAT is the angle of the apparent wind to the centerline of the boat. Once again, positive numbers indicate starboard and negative numbers port with a range of 0° to 180°.

Between the information in the legend and the image of the boat moving across the screen, you can get a fair idea of how a boat sails.

For an even closer look, you can type V and toggle to the vector diagram mode. In this mode there are two boats on the screen. The one on the left shows the real wind, which is the vertical line going to the center of the boat, the motion of the boat, which is the line furthest from the real wind, and the apparent wind, which is the line between the other two.

On the right diagram I show the lift force generated by the sail, which is the line closest to the front of the boat (unless you are sailing by the lee). The rearmost line, often too small to be seen, is the drag force, and the line between them is the total force of the wind on the boat.



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A Short Sailing Glossary

Abaft: Behind.

Abeam: At 90° to the boat.

Apparent Wind: Vector sum of real wind and the motion of the boat.

Athwartships: Across the boat.

Beam: The widest part of a boat, the width of a boat.

Beat, Beating: To sail into the wind.

Boat: A hole in the water into which one throws money.

Boom: The stick to which the bottom of a sail is attached.

Bow: The front of a boat.

Displacement Hull: A hull designed to go through the water rather than slide over it.

Drag: Force in line with the wind.

Forestay: Wire that keeps the mast from tipping backwards.

Genoa: Large overlapping jib.

Headed: Being hit by a wind shift that moves you away from your objective.

Heeling: Being tipped part way over by the wind.

Hull: The body of the boat.

Jib: Sail set between mast and bow of boat. Usually on the forestay.

Jibe: To have a sail suddenly and often violently swing from one side to the other while sailing downwind.

L/D: Lift to drag ratio.

Lift: A force 90° to the wind felt by an object.

Lee: The downwind direction. The sheltered side of something.

Leeway: The slight sideward motion of a sailboat in the downwind (leeward) direction.

Luffing: Flapping in the breeze.

Mast: Tall stick, usually near middle of the boat, that holds sails up. Some boats have more than one.

Mooring: A float anchored to the bottom to which one ties a boat. The act of tying a boat to a mooring.

Port: The left side of the boat. A harbor.

Reach: Sail across the wind.

Run: Sail downwind.

Starboard: The right side of the boat.

Sheet: Rope used to trim (adjust) a sail.

Sheet In: Pull a sail tight, or tighter.

Sloop: A boat with one mast and two fore and aft rigged sails.

Tack: To zig zag into the wind. Alternatively, which side of the wind you are sailing on.

Tiller: Arm attached to rudder used to steer.

Trim: Adjust.

Trimmable: Adjustable.

Vang: A device used to keep the boom from pivoting up.

Vector: A quantity that has both magnitude and direction. The magnitude represents force or speed.

Windward: Toward the wind.

Not shown in the diagram are the lift and drag characteristics of the hull and how it resolves the force of the wind into forward motion. I just assume a twenty to one L/D ratio (which means that the boat is twenty times harder to move sideways than forward).

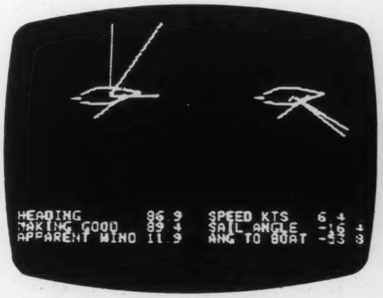
The display on most Apples can be stopped with a CTRL-S allowing a careful study of a single frame.

Some definitions are in order before I explain how the program works. I will call the sail an airfoil in the sense that anything that interacts with moving air may be so described. Airfoils possess two significant characteristics, lift and drag, both of which may be measured at various angles of attack (sail angles in this program).

Lift is a force at 90° to the wind. The program calculates the lift of the sail by multiplying the square of the apparent wind by a number selected by the sail angle from an array that represents the lift characteristic of the sail (see Figure 1).

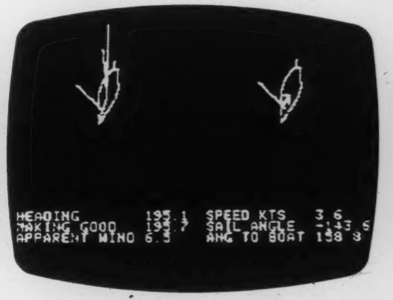
Drag is a force in line with the wind. Drag force is calculated in a manner similar to lift using a sinusoidal curve (see Figure 2) starting at a base value that represents the windage of the hull and spars and hits a peak at 100°, then drops back to the base value again (100° degrees instead of 90 because I set the minimum drag to 10° since the luffing sail has a higher drag than the sail that has just stopped luffing).

The sine function of Basic is used to generate an appropriate array that covers 180° of operation. The values in both arrays are arbitrary. Only the relationship of the value of one angle to another



```
HEADING        86.9   SPEED KTS    6.4
MAKING GOOD    89.4   SAIL ANGLE  -16.4
APPARENT WIND 11.9    ANG TO BOAT -53.8
```

Photo 5. Vector diagram of the beam reach. Notice that the total force vector is smaller than during the windward sailing but the boat is moving faster. This is because the forward component is larger for a reaching situation, and the leeway is less.



```
HEADING       195.1   SPEED KTS    3.6
MAKING GOOD   195.7   SAIL ANGLE  -143.6
APPARENT WIND 6.5     ANG TO BOAT 138.8
```

Photo 6. Sailing by the lee. Sailing downwind with the sail on the wrong side. Notice that the apparent wind is only 6.5 kts. The force of the wind goes up with the square of the speed, so the forces shown by the right boat are very small compared to the windward situation of Photo 4. The lift vector here points west and is generated by negative peak of the lift curve (see Figure 1).

```
...............JIBE HO!!!
```

Photo 7. This is the jibe warning message. This boat jibes with less fuss than anything I have sailed except a windsurfer so I have the program announce the jibes.

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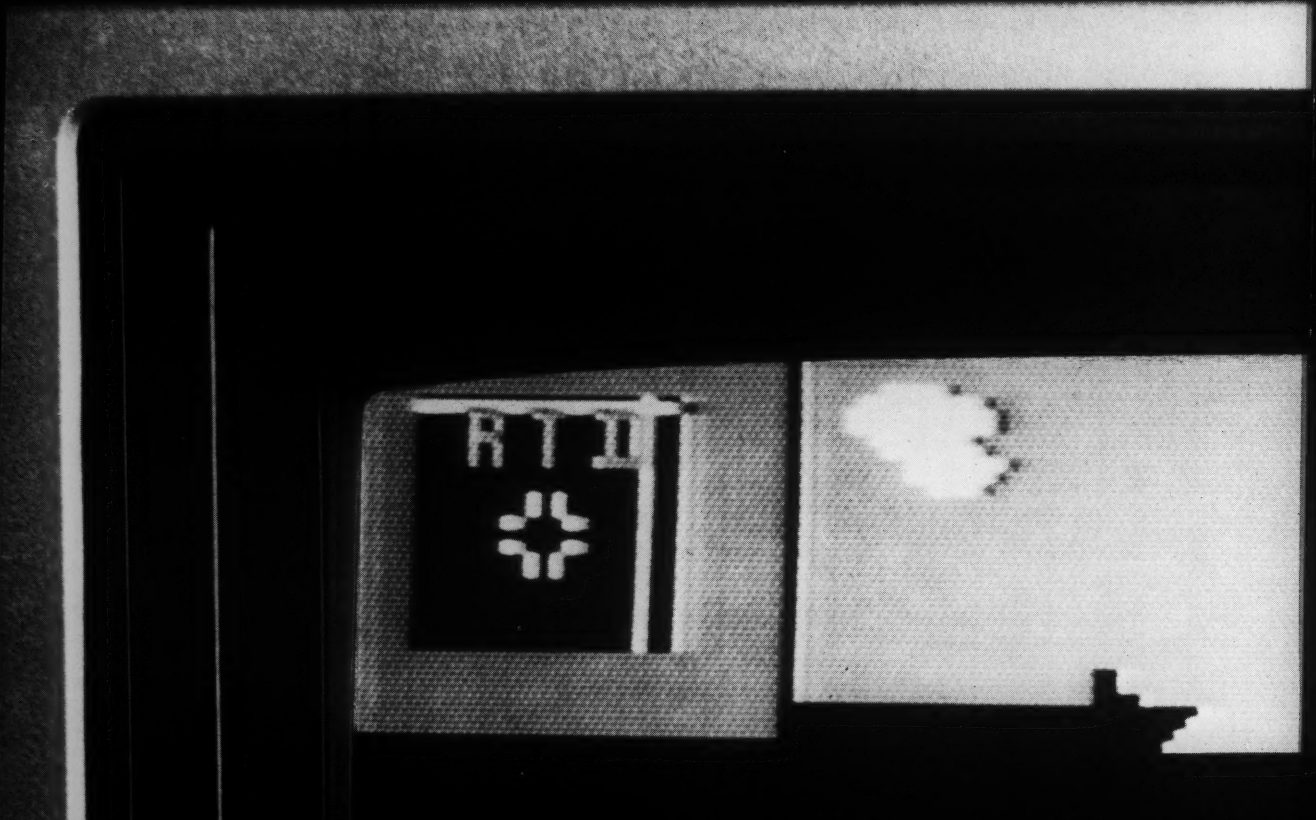

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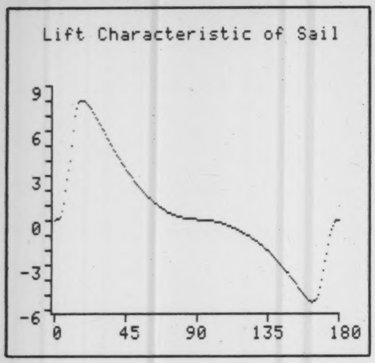


Figure 1. This is the Lift Characteristic of the sail. The numbers on the Y axis are arbitrary, only the relationship between the value for one angle and another and the relationship to the drag characteristic are important.

and the relationship of the value of the arrays to each other are significant.

The arrays that represent the lift and drag characteristic of the sail are speculative, but in concept I believe them to be fair representations of the actual lift and drag curves of a real sail (see Figure 3).

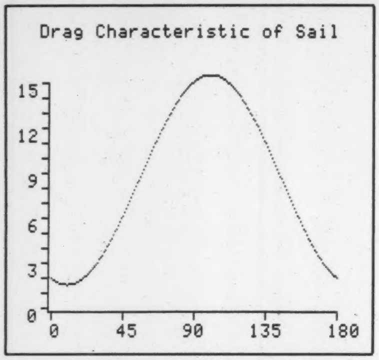


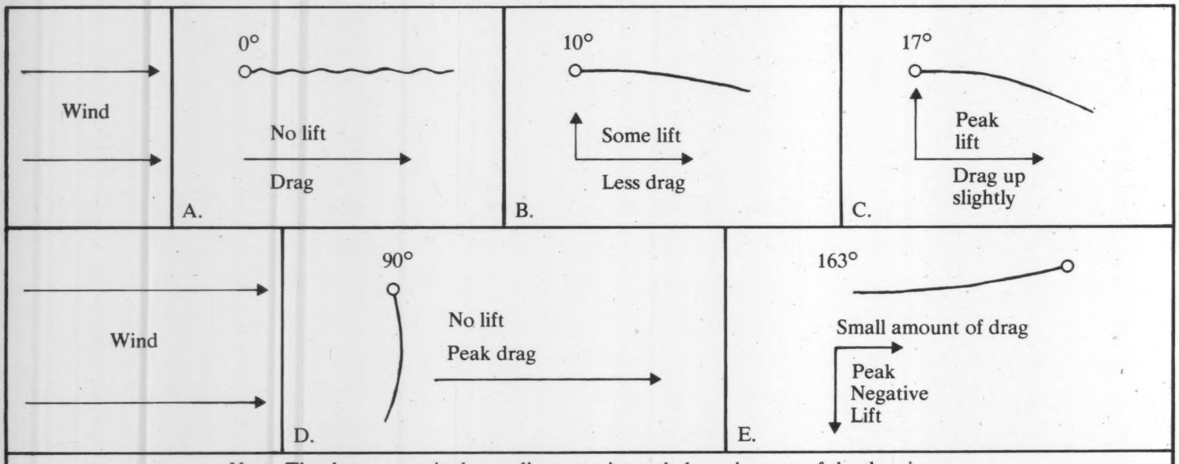
Figure 2. This is the Drag Characteristic. The peak value was arrived at empirically while trying to make the boat behave in a realistic manner. Notice that the drag has a base value of 1.5. This represents the drag of the hull and spars. Without this base value in the Drag Characteristic, the boat would need an engine to leave the mooring.

The program is relatively straightforward and with the aid of the variable table should be understandable with some study. The init section is at the end of the program. When the program goes into hi-res mode, the screen chops the back of the program off. Beware of this. Do not save the program after running it because it is not all there.

The subroutines that do the turtle graphics and the vector calculations are both written in map convention, with 0° at the north and numbers increasing clockwise, instead of 0° being east and the numbers increasing counterclockwise. I hope that explains the nonstandard arrangement of sine versus cosine.

The jibe routine beginning at line 1720 and the acceleration section at line 2790 may require some thought but the only thing that needs explanation is the purpose of the routine at lines 2550 to 2580 which is to keep the boat from responding to changes in sail trim with sudden large changes in leeway.

A careful look at the program will show that shortcuts have been taken in the interest of speed and simplicity. My sincere apologies to the laws of physics for some of these. The goal of this simulation is realistic and predictable performance. The approach I took was to find an appropriate imitation of the behavior of a boat, rather than a painstaking model of each facet of the problem. I hope you like it. Happy sailing. ☐



Note: The drag vector is shown disproportionately large in most of the drawings.

Figure 3. This is the sail in an imaginary wind tunnel. The known data is that lift starts from zero and hits a peak at about 17°, then drops off sharply. From there it must fall to 0 at 90°, and for similar reasons there is probably also a peak at 163°, only in the negative direction. The drag curve should start at the base value that represents windage, then increase to a peak at 90° then fall back again. I feel that the luffing sail has slightly more drag than the sail that is just filled, so I set the low drag to 10°—anything to improve windward performance. Frame A shows the luffing sail—no lift and drag slightly above the base line. Frame B has the sail at 10° where I think the drag drops to its lowest value. At this point lift reaches more than half its total value. In Frame C we have peak lift, with the drag up slightly. Incidentally, the best lift to drag ratio almost always occurs at an angle less than the peak lift angle, and I/D is what you need to go to windward. On the other hand, the peak lift will drive you faster in a reaching situation. Frame D shows the sail at 90°—no lift here, but peak drag. This is what you want (or must use) to sail down wind. Frame E shows the sail at 163°. Once the sail is past 90°, it starts generating lift in a downward direction. Based on the assumption that the 17° peak applies in either direction, but that the sail works more efficiently in the direction it was made to work, I finished the lift curve with the negative peak shown in Figure 1.

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CIRCLE 220 ON READER SERVICE CARD

Variables Used In Hi-Res Sailboat

A	(Utility)	Represents angle for turtle and vector sum subroutines. Also used as utility variable in sail angle routine.
AN	(Angle)	Holds angle for turtle routine.
AR	(Aspect Ratio)	Sets height to width. Adjust for your monitor in initialization section (constant).
BW	(Boat Wind)	Relative direction of the wind to the long axis of boat.
CR	(Convert Radians)	Convert radians to degrees (constant).
D1	(Utility)	Carries direction information to vector sum subroutine.
D2	(Utility)	Same as above.
D3	(Utility)	Carries direction information from Vector Sum subroutine.
DB	(Direction Boat)	The compass heading of the long axis of the boat.
DD	(Direction Drag)	The direction of the drag vector.
DF	(Direction Force)	The direction of the total force vector acting on the boat.
DH	(Direction Headed)	The actual direction in which the boat is moving.
DL	(Direction Lift)	The direction of the lift vector.
DR	(Direction Real)	The direction of the real wind (constant).
DX	(Direction Apparent)	The direction of the apparent wind. (Vector sum of real wind and boat motion.)
D(	(Array)	The drag array.
H	(Utility)	Horizontal quantity used in polar to rect. subroutine.
H1	(Utility)	Horizontal input to vector sum subroutine.
H2	(Utility)	Same as above.
H3	(Utility)	Horizontal output of vector sum subroutine.
I	(Utility)	For-Next loop control.
J	(Utility)	Same as above.
LR	(Lateral Resistance)	Lateral resistance, used in adjusting the leeway of boat (constant).
LW	(Leeway)	The difference between the compass course and the course made good.
L(	(Array)	The lift array.
M1	(Utility)	Magnitude information for the vector sum subroutine.
M2	(Utility)	Same as above.
M3	(Utility)	Magnitude output from vector sum subroutine.
MA	(Mass)	The displacement of the boat (constant).
MB	(Magnitude Boat)	The speed of the boat.
MD	(Magnitude Drag)	The magnitude of the drag.
MF	(Magnitude Force)	The magnitude of the total wind force acting on boat (lift and drag).
ML	(Magnitude Lift)	The magnitude of the lift.
MO	(Move)	Passes how far to move to the turtle routine.
MR	(Magnitude Real)	The magnitude of the real wind (constant).
MX	(Magnitude Apparent)	The magnitude of the apparent wind (vector sum of MR + MB).
M(	(Move Array)	Stores the lengths of lines used to draw boat.
OQ	(Old Q)	Stores old value of Q for keypress processing.
OX	(Old X)	Saves X position of boat while using vector diagram mode.
OY	(Old Y)	Saves Y as above.
Q	(Utility)	Stores keypress information.
Q$	(Utility)	Accepts input.
RA	(Rudder Angle)	The angle calculated from the paddle setting.
RC	(Radian Convert)	Converts degrees to radians (constant).
SA	(Sail Angle)	The angle of the sail to the wind.
SF	(Sail Freedom)	The slack in the sheets (sail control lines) according to paddle setting.
SI	(Size)	Sets relative size of drawing (constant).
TF	(Total Force)	Temporary storage for total force angle.
TM	(Total Magnitude)	Temporary storage for total magnitude.
T(	(Turn Array)	Stores the angle of turn for the draw boat routine.
V	(Utility)	Vertical quantity used in turtle subroutine.
V1	(Utility)	Vertical input to vector sum subroutine.
V2	(Utility)	Same as above.
V3	(Utility)	Vertical output from vector sum subroutine.
X	(Utility)	Next X position of plotted point from turtle subroutine.
XX	(Horizontal Location)	The current horizontal location of the boat.
Y	(Utility)	Next Y position of plotted point from turtle subroutine.
YY	(Vertical Location)	The current vertical location of the boat.
ZZ	(Utility)	Stores numbers for the screen legend.

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CIRCLE 247 ON READER SERVICE CARD

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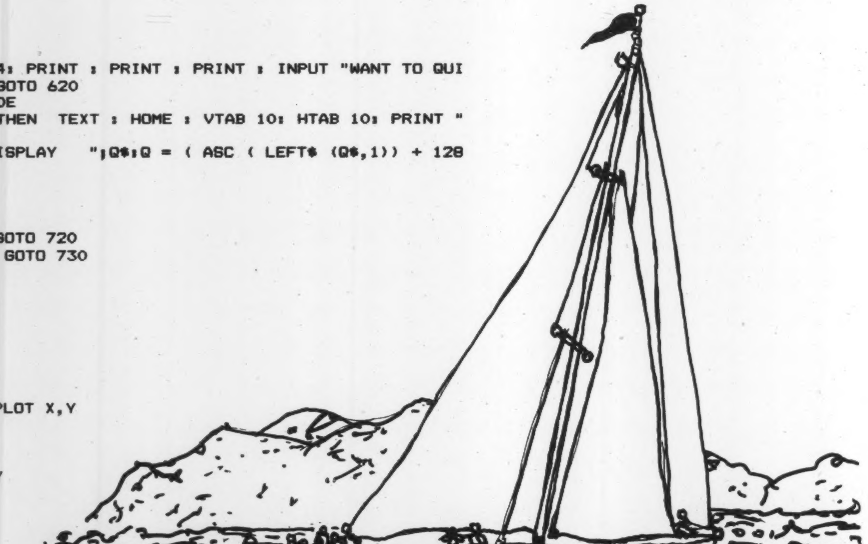
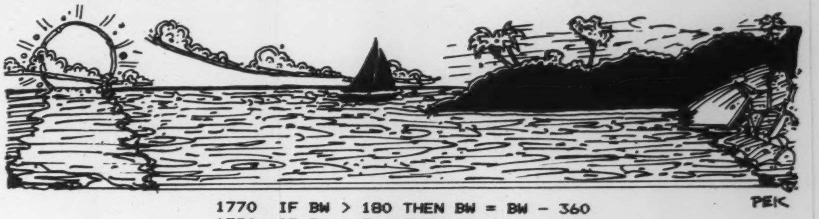
```
100  LOMEM: 16384
110  TEXT : HOME : GOTO 3170
120  REM
130  REM *** TURTLE ***
140  REM
150  LET ANGLE = ANGLE + TURN
160  LET A = ANGLE * RC
170  LET MOVE = MOVE * SIZE
180  LET H = MOVE *  SIN (A) * AR
190  LET V = MOVE *  COS (A)
200  LET X = X + H
210  LET Y = Y - V
220  LET TURN = 0
230  RETURN
240  REM
250  REM *** VECTOR SUM ***
260  REM
270  LET A = D1 * RC
280  LET H1 = M1 *  SIN (A)
290  LET V1 = M1 *  COS (A)
300  LET A = D2 * RC
310  LET H2 = M2 *  SIN (A)
320  LET V2 = M2 *  COS (A)
330  LET H3 = H1 + H2
340  LET V3 = V1 + V2
350  LET M3 =  SQR (H3 ^ 2 + V3 ^ 2)
360  IF V3 = 0 THEN V3 = .000000001
370  LET D3 =  ATN (H3 / V3) * CR
380  IF V3 < 0 THEN D3 = D3 + 180
390  IF H3 < 0 AND V3 > 0 THEN D3 = D3 + 360
400  RETURN
410  REM
420  REM ** SCREEN LEGEND **
430  REM
440  REM TYPE SPACES INSTEAD OF      PERIODS
450  REM
460  VTAB 21: PRINT "HEADING..............SPEED KTS..........MAKING GOOD.
     ..........SAIL ANGLE.........APPARENT WIND........ANG TO BOAT": RETURN

470  REM
480  REM ************************
490  REM *                      *
500  REM *      MAIN LOOP       *
510  REM *                      *
520  REM ************************
530  REM
540  REM ** PROCESS KEYPRESS **
550  REM
560  LET OQ = Q
570  POKE ( - 16368),0
580  IF Q = 205 THEN 720
590  REM IF KEYPRESS = M
600  IF Q = 209 THEN  VTAB 24: PRINT : PRINT : PRINT : INPUT "WANT TO QUI
     T? TYPE Y OR N   ";Q$: GOTO 620
610  GOTO 650: REM VECTOR MODE
620  IF  LEFT$ (Q$,1) = "Y" THEN  TEXT : HOME : VTAB 10: HTAB 10: PRINT "
     HAPPY SAILING": END
630  INPUT "TYPE M OR V TO DISPLAY   ";Q$:Q = ( ASC ( LEFT$ (Q$,1)) + 128
     ): GOSUB 460: GOTO 480
640  GOSUB 460
650  FOR I = 1 TO 2
660  LET YY = 79
670  IF I = 1 THEN XX = 70: GOTO 720
680  IF I = 2 THEN XX = 210: GOTO 730
690  REM
700  REM **   DRAW HULL   **
710  REM
720  HGR
730  LET ANGLE = DB
740  LET MOVE = 4
750  LET X = XX
760  LET Y = YY
770  HCOLOR= 7: GOSUB 150: HPLOT X,Y
780  FOR J = 1 TO 7
790  LET TURN = T(J)
800  LET MOVE = M(J)
810  GOSUB 150: HPLOT  TO X,Y
820  NEXT
830  REM
840  REM *** DRAW SAIL ***
850  REM
860  LET ANGLE = DB
870  LET MOVE = 2
880  LET X = XX
890  LET Y = YY
```



```
900  GOSUB 150: HPLOT X,Y
910  IF BW > 180 THEN BW = BW - 360
920  LET A =  SGN (SA): IF A = 0 THEN  LET A =  SGN (BW)
930  IF  ABS (BW) > SF THEN  LET ANGLE = ANGLE + SF * A + 180: GOTO 950
940  LET ANGLE = ANGLE + BW + 180
950  LET MOVE = 5
960  GOSUB 150: HPLOT  TO X,Y
970  REM
980  REM *** DRAW RUDDER ***
990  REM
1000  LET ANGLE = DB
1010  LET MOVE =  - 4
1020  LET X = XX
1030  LET Y = YY
1040  GOSUB 150: HPLOT X,Y
1050  LET ANGLE = DB - RA + 180
1060  LET MOVE = 1
1070  GOSUB 150: HPLOT  TO X,Y
1080  IF Q = 205 THEN 1510
1090  IF I = 2 THEN  GOTO 1280
1100  REM
1110  REM *** DRAW REAL WIND ***
1120  REM
1130  LET X = XX: LET Y = YY: HPLOT X,Y
1140  LET ANGLE = 0: LET MOVE = MR
1150  GOSUB 150: HPLOT  TO X,Y
1160  REM
1170  REM * DRAW APPARENT WIND *
1180  REM
1190  LET X = XX: LET Y = YY: HPLOT X,Y
1200  LET ANGLE = DX: LET MOVE = MX
1210  GOSUB 150: HPLOT  TO X,Y
1220  REM
1230  REM ** DRAW BOAT MOTION **
1240  REM
1250  LET X = XX: LET Y = YY: HPLOT X,Y
1260  LET ANGLE = DH: LET MOVE = MB
1270  HCOLOR= 6: GOSUB 150: HPLOT  TO X,Y: HCOLOR= 7
1280  IF I = 1 THEN  GOTO 1470
1290  REM
1300  REM * DRAW SAILFORCE *
1310  REM
1320  LET X = XX: LET Y = YY: HPLOT X,Y
1330  LET ANGLE = DL: LET MOVE = ML / 260
1340  GOSUB 150: HPLOT  TO X,Y
1350  REM
1360  REM * DRAW TOTAL DRAG *
1370  REM
1380  LET X = XX: LET Y = YY: HPLOT X,Y
1390  LET ANGLE = DD: LET MOVE = MD / 260
1400  GOSUB 150: HPLOT  TO X,Y
1410  LET X = XX: LET Y = YY: HPLOT X,Y
1420  REM
1430  REM ** TOTAL FORCE **
1440  REM
1450  LET ANGLE = TF: LET MOVE = TM / 260
1460  GOSUB 150: HPLOT  TO X,Y
1470  NEXT I
1480  REM
1490  REM * FIND APPARENT WIND *
1500  REM
1510  LET D1 = DH
1520  LET D2 = DR
1530  LET M1 = MB
1540  LET M2 = MR
1550  GOSUB 270
1560  LET DX = D3
1570  LET MX = M3
1580  REM
1590  REM *** TURN BOAT ***
1600  REM
1610  LET RA =  PDL (0) / 2.55 - 50
1620  LET DB = DB + (RA *  SQR (MB) *  SGN (RE)) / 5
1630  REM *********************
1640  REM *                   *
1650  REM *    SAIL ANGLE     *
1660  REM *                   *
1670  REM *       AND         *
1680  REM *                   *
1690  REM *  JIBE ROUTINE.    *
1700  REM *                   *
1710  REM *********************
1720  IF DB > 360 THEN DB = DB - 360
1730  IF DB < 0 THEN DB = DB + 360
1740  LET SF = (255 -  PDL (1)) / 5 + 15
1750  IF DB > DX THEN DX = DX + 360
1760  LET BW = DX - DB
```



```
1770  IF BW > 180 THEN BW = BW - 360
1780  IF DX > 360 THEN DX = DX - 360
1790  IF SF >  ABS (BW) THEN SA = 0: GOTO 2020
1800  IF  SGN (BW) =  - 1 THEN BW = BW + 360
1810  IF SA > 0 THEN 1920
1820  IF SA < 0 THEN 1930
1830  GOTO 1890
1840  VTAB 24: PRINT : PRINT "................JIBE HO!!!"
1850  PRINT : PRINT
1860  FOR I = 1 TO 500: NEXT
1870  GOSUB 460
1880  REM RE-INIT SCREEN LEGEND
1890  IF BW > 180 THEN BW = BW - 360
1900  IF  SGN (BW) = 1 THEN SA = BW - SF: GOTO 2020
1910  LET SA = BW + SF: GOTO 2020
1920  LET SA = BW - SF: GOTO 1940
1930  LET SA = BW - 360 + SF
1940  IF  ABS (SA) > 180 THEN 1840
1950  REM *********************
1960  REM *                   *
1970  REM * FIND VECTOR SUM   *
1980  REM *                   *
1990  REM * OF LIFT AND DRAG  *
2000  REM *                   *
2010  REM *********************
```

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Where is he going?

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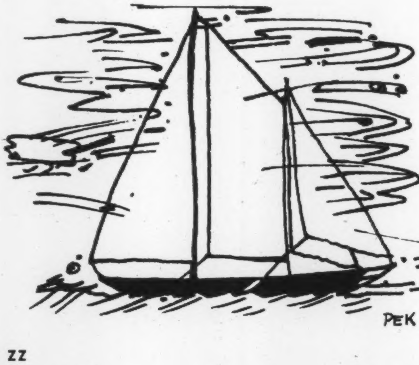
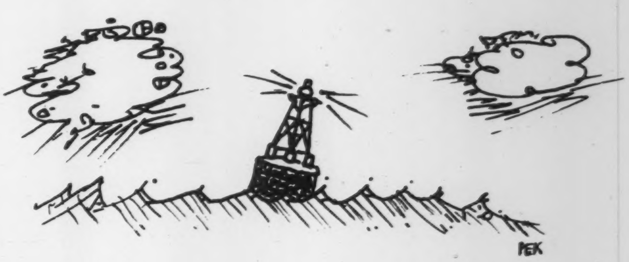
CIRCLE 118 ON READER SERVICE CARD

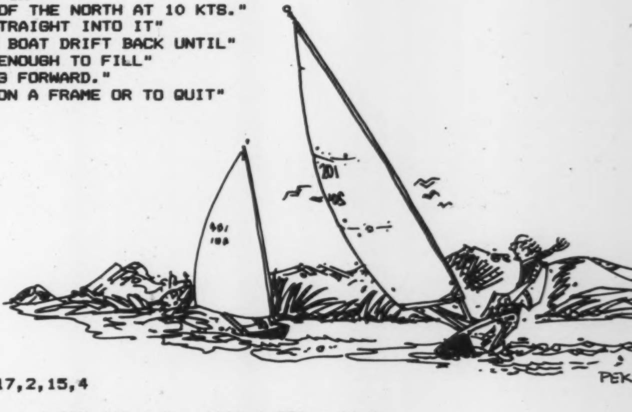
Hi-Res Sailboat, continued...

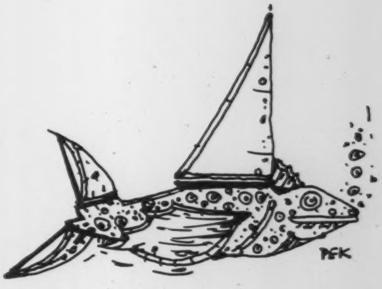
```
2020  IF SA =  > 0 THEN DL = DX - 90
2030  IF SA < 0 THEN DL = DX + 90
2040  IF DL > 360 THEN DL = DL - 360
2050  IF DL < 0 THEN DL = DL + 360
2060  LET ML = 2 * (L( ABS (SA)) * MX ^ 2)
2070  LET DD = DX + 180
2080  IF DD > 360 THEN DD = DD - 360
2090  LET MD = D( ABS (SA)) * MX ^ 2
2100  LET D1 = DL:D2 = DD:M1 = ML:M2 = MD
2110  GOSUB 240
2120  LET DF = D3:MF = M3
2130  LET TF = DF: LET TM = MF
2140  REM TF AND TM FOR VECTOR         DISPLAY
2150  REM
2160  REM *******************
2170  REM *                 *
2180  REM * NORMALIZE FORCE *
2190  REM *                 *
2200  REM *     TO HULL     *
2210  REM *                 *
2220  REM *******************
2230  REM
2240  LET DF = DF - DB
2250  IF DF < 0 THEN DF = DF + 360
2260  LET D1 = DF:D2 = 0:M1 = MF:M2 = 0
2270  GOSUB 240
2280  REM
2290  REM **********************
2300  REM *                    *
2310  REM * DIRECTION OF FORCE *
2320  REM *                    *
2330  REM *     MODIFIED BY    *
2340  REM *                    *
2350  REM * LATERAL RESISTANCE *
2360  REM *                    *
2370  REM **********************
2380  REM
2390  LET H1 = H1 / LR
2400  LET H3 = H1:V3 = V1
2410  GOSUB 340
2420  LET DF = D3:MF = M3
2430  IF DF > 180 THEN DF = DF - 360
2440  REM
2450  REM **    FIND LEEWAY   **
2460  REM **                  **
2470  REM **  RATE OF CHANGE  **
2480  REM ** AFFECTED BY MASS **
2490  REM **                  **
2500  REM ** SGN (RE) SAYS    **
2510  REM ** WHICH WAY THE    **
2520  REM ** RUDDER TURNS THE **
2530  REM ** BOAT.            **
2540  REM
2550  LET D1 = LW:D2 = DF
2560  LET M1 = MB
2570  LET M2 = MF / (MA / 5)
2580  GOSUB 240
2590  LET LW = D3:RE = V3
2600  IF DF < 0 THEN DF = DF + 360
2610  IF LW > 180 THEN LW = LW - 360
2620  IF BW > 180 THEN BW = BW - 360
2630  REM
2640  REM **********************
2650  REM *                    *
2660  REM * LEEWAY & BOATWIND  *
2670  REM *                    *
2680  REM * BOTH + OR - CENTER *
2690  REM *                    *
2700  REM * OF BOAT (- = PORT) *
2710  REM *                    *
2720  REM **********************
2730  REM
2740  REM THIS IS WHERE FORCE
2750  REM ACCELERATES BOAT
2760  REM
2770  REM AND DRAG SLOWS IT.
2780  REM
2790  LET MB = MB + (MF / MA) - ( ABS (MB) * .2) ^ 2.1
2800  LET DH = DB + LW: IF DH < 0 THEN DH = DH + 360
2810  IF DH > 360 THEN DH = DH - 360: GOTO 2810
2820  LET D1 = DH:D2 = 0:M1 = MB:M2 = 0: GOSUB 240
2830  VTAB 21: HTAB 15: PRINT "      "
2840  VTAB 21: HTAB 34: PRINT "      "
2850  VTAB 22: HTAB 15: PRINT "      "
2860  VTAB 22: HTAB 34: PRINT "      "
2870  VTAB 23: HTAB 15: PRINT "      "
2880  VTAB 23: HTAB 34: PRINT "      "
2890  LET ZZ =  INT (DB * 10 + .5) / 10: VTAB 21: HTAB 15: PRINT ZZ
2900  LET ZZ =  INT (MB * 10 + .5) / 10: VTAB 21: HTAB 34: PRINT ZZ
```



```
2910  LET ZZ =  INT (DH * 10 + .5) / 10: VTAB 22: HTAB 15: PRINT ZZ
2920  LET ZZ =  INT (SA * 10 + .5) / 10: VTAB 22: HTAB 34: PRINT ZZ
2930  LET ZZ =  INT (MX * 10 + .5) / 10: VTAB 23: HTAB 15: PRINT ZZ
2940  IF DX > 180 THEN DX = DX - 360
2950  IF DB > 180 THEN DB = DB - 360
2960  LET DB = DB *  - 1
2970  LET ZZ =  INT ((DB + DX) * 10 + .5) / 10: VTAB 23: HTAB 34: PRINT ZZ
2980  IF DX < 0 THEN DX = DX + 360
2990  LET DB = DB *  - 1
3000  IF DB < 0 THEN DB = DB + 360
3010  IF  PEEK ( - 16384) = 205 OR  PEEK ( - 16384) = 209 OR  PEEK ( - 16
     384) = 214 THEN 3040
3020  GOTO 3050
3030  IF Q = 209 THEN 600
3040  LET Q =  PEEK ( - 16384)
3050  REM CHOOSE DIAGRAM OR           MOVING BOAT
3060  IF Q = 214 THEN 470
3070  IF OQ <  > 214 THEN 3090
3080  LET XX = OX:YY = OY
3090  LET XX = XX + H3 * SIZE
3100  LET YY = YY - V3 * SIZE
3110  IF XX > 250 THEN XX = 30
3120  IF XX < 30 THEN XX = 250
3130  IF YY > 130 THEN YY = 30
3140  IF YY < 30 THEN YY = 130
3150  LET OX = XX:OY = YY
3160  GOTO 470: REM LOOP
3170  VTAB 4: PRINT "                    2D  VECTOR"
3180  PRINT : PRINT "                     SAILBOAT"
3190  PRINT : PRINT : PRINT "INSTRUCTIONS:"
3200  PRINT : PRINT "    PADDLE (0) CONTROLS THE RUDDER"
3210  PRINT "    PADDLE (1) CONTROLS THE SAIL"
3220  PRINT "    CLOCKWISE IS SHEETED IN"
3230  PRINT : PRINT "THE WIND IS OUT OF THE NORTH AT 10 KTS."
3240  PRINT "AND THE BOAT IS FACING STRAIGHT INTO IT"
3250  PRINT : PRINT "YOU MUST LET THE BOAT DRIFT BACK UNTIL"
3260  PRINT "YOU ARE ABLE TO TURN IT ENOUGH TO FILL"
3270  PRINT "THE SAIL AND START MOVING FORWARD."
3280  PRINT : PRINT "PRESS Q TO HALT ON A FRAME OR TO QUIT"
3290  LET SIZE = 5
3300  LET RC = 3.1415927 / 180
3310  LET CR = 1 / RC
3320  LET AR = 1.15
3330  LET DR = 0: REM FROM NORTH
3340  LET MR = 10: REM AT 10
3350  LET MA = 1000: REM MASS
3360  LET LR = 20: REM LAT RESIS
3370  LET XX = 139:OX = XX
3380  LET YY = 79:OY = YY
3390  LET DB = 0: REM HEADING
3400  DIM T(7),M(7)
3410  FOR I = 1 TO 7
3420  READ T(I)
3430  READ M(I)
3440  NEXT
3450  DATA 165,4,15,2,17,2,73,1,73,2,17,2,15,4
3460  DIM L(180),D(180)
3470  FOR I = 0 TO 180: READ L(I):D(I) = ( SIN ((I * 2 - 110) * RC) + 1) *
     7 + 1.5: NEXT I
3480  PRINT
3490  INVERSE : PRINT "MOVING BOAT OR VECTOR DIAGRAM?": NORMAL : INPUT "(
     TYPE M OR V AND PRESS RETURN) ";Q$:Q$ =  LEFT$ (Q$,1)
3500  IF Q$ = "M" THEN Q = 205
3510  IF Q$ = "V" THEN Q = 214
3520  IF Q$ = "M" OR Q$ = "V" THEN 3540
3530  VTAB 21: HTAB 15: FLASH : PRINT "TRY AGAIN": NORMAL : GOTO 3490
3540  GOSUB 460
3550  GOTO 470
3560  DATA  0,.02,.05,.11,.23,.55,1.1,2,2.65,3.3,4,5,6,6.9,7.44,7.78,7.95
     ,8,7.98,7.92,7.82
3570  DATA 7.72,7.59,7.42,7.24,7.05,6.85,6.69,6.48,6.3,6.1,5.88,5.66,5.5,
     5.31,5.12,4.93,4.74,4.56,4.37,4.18
3580  DATA 4.02,3.85,3.68,3.52,3.36,3.2,3.06,2.9,2.76,2.53,2.4,2.26,2.13,
     2.03,1.9,1.79,1.7,1.6,1.5,1.39
3590  DATA 1.29,1.2,1.11,1.01,.93,.85,.77,.7,.63,.53,.5,.46,.41,.37,.33,.
     28,.24,.21,.18,.15
3600  DATA .12,.1,.08,.06,.05,.04,.03,.02,.01,0,-.01,-.02,-.03,-.04,-.05,
     -.07,-.08,-.09,-.1,-.12
3610  DATA -.14,-.17,-.2,-.22,-.24,-.27,-.31,-.35,-.39,-.43,-.47,-.51,-.5
     6,-.62,-.67,-.73,-.78,-.84,-.89,-.95
3620  DATA  -1,-1.06,-1.12,-1.19,-1.25,-1.32,-1.39,-1.46,-1.55,-1.63,-1.7
     2,-1.8,-1.89,-2,-2.1,-2.2,-2.3,-2.4,-2.52,-2.65
3630  DATA -2.75,-2.88,-3,-3.13,-3.26,-3.38,-3.5,-3.62,-3.75,-3.9,-4.05,-
     4.2,-4.37,-4.53,-4.67,-4.77,-4.93,-5.08,-5.22,-5.32
3640  DATA -5.41,-5.46,-5.5,-5.49,-5.43,-5.28,-5.05,-4.5,-4,-3.4,-2.87,-2
     .35,-1.65,-1,-.65,-.42,-.24,-.11,-.02,0
```







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The new Epson FX-80 is far more than just doo-dads added on to last year's model. It's the most astonishing collection of features ever assembled in a personal printer.

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But that hardly scratches the surface.

Create your own alphabet.

With the new FX-80, you aren't limited to ASCII characters. You can create your own. Any character or symbol that can be defined in a 9x11 matrix can be added to the FX-80's already impressive library of type styles and stored in its integral 2K RAM.

So you can create "Sally's Gothic" or "Tom's Roman" just by downloading and modifying standard characters. Or you can create a custom set from scratch. Either way, you can store up to 256 new characters. And if you don't need a new alphabet, the RAM functions as a 2K data input buffer.

Who knows graphics better than Epson?

Nobody, that's who. And if you don't believe it, witness the FX-80.

With a 12K ROM capacity, the FX-80 gives you a few things the others don't. For example, not one, not two, but *seven* different dot addressable graphic modes are program selectable. And can be mixed in the same print line. Everything from 72 DPI (dots-per-inch) Plotter Graphics to the 640 dots per line resolution designed to match the remarkable monitor clarity of the Epson QX-10 personal computer.

And *that* is in addition to an astonishing array of 136 different user-selectable type styles including Proportional, Elite and Italic as well as the more conventional faces you get on other printers.

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The FX-80 has all the hardware features you've come to know and love on the MX Series: logic seeking, bidirectional printing, the by-now-famous disposable printhead, and more.

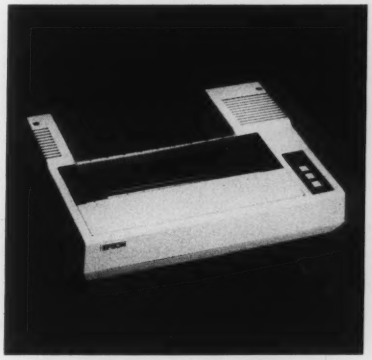
The FX-80 features an adjustable pin platen or optional friction/tractor feed, so you can use fanfold, roll or sheet paper . . . backwards or forwards. The FX-80 even gives you reverse paper feed.

And if you're printing forms, the FX-80 has a feature you're gonna love: a function that allows you to tear off the paper within one inch of the last print position.

Be the first on your block.

We'd be willing to bet that the FX-80 — like the MX-80 — will have its share of imitators. Don't be fooled. To make sure you get the genuine article, rush down to your local computer store right now and let them show you everything the FX-80 can do.

And while you're there . . . ask them to show you how it works with our computers.



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CIRCLE 205 ON READER SERVICE CARD

An Adventure Game For The Bally Arcade and Commodore Vic 20

Cavern Quest

Bruce Jaeger

The Bally Arcade (or Astrocade) is probably the most undersung of the home computer systems, and undeservedly so. The color graphics and sound capabilities were, and in many cases still are, years ahead of the competition, both in the cartridge games and with Bally Basic. The most serious limitations have been the small, calculator-style keyboard and the mere 1800 bytes of RAM.

Was I crazy then, to attempt to write an adventure game for the Bally? Perhaps. But I tried, and I think you will enjoy the result.

I knew that no magic was strong enough to fit any kind of traditional Adventure game into those 1800 bytes. In addition, a novice at the Bally keypad could take days to type in "Take the Amulet," so I elected to use joystick 1 for input.

The scenario of the game is straightforward. Jesse James, the Robin Hood or Attila the Hun of Missouri (depending on your point of view), has hidden a treasure deep in a cave, and you want to go in, find it, and bring it out. That's it. No magic birds, sword-wielding ogres or dissembling oracles. Not only would that have been quite a task in 1800 bytes, but it turns out that a simple, realistic exploration of a three-dimensional cave is difficult enough, thank you.

The cavern passages do not form a traditional maze, as there is often more than one path to the treasure, and any path is liable to loop back on itself—sometimes in an inexplicable way. Make a map.

The Program

The first third of the program generates the passages of the cave, using the random number generator, so unlike most adventure games, the cave is different each time. Also at this time the various artifacts of the James boys are strewn about, and the treasure hidden. It takes about half a minute or so for the computer to do its work.

The rest of the program is the playing section. The player enters the cave, and is told whether passages lead north, south, east, west, up or down. Pushing the joystick forward is the equivalent of saying Go North, and the other compass directions correspond.

As you will never get both an Up and a Down choice at the same point, a simple pull of the trigger (or firing button) suffices to indicate climb or descent. Then it is simply a matter of wandering through the cave, keeping track of where you are, finding the treasure, and making your way out again.

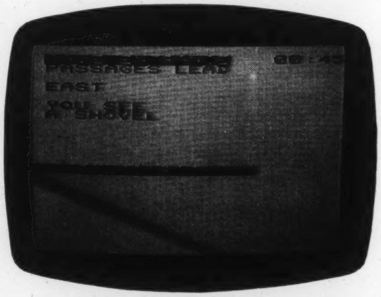
To make the cavern as large as possible none of the fine Bally sound effects or graphics other than color changes have been used. Because of the restricted memory, it is also important not to type in any spaces between commands, except as noted in lines 54 and 55.

Vic Version

I have included a translation of Cavern Quest for the Vic computer (or any other regular Basic computer, with modifications), as Bally Basic code is often difficult to translate. The cavern can be made much larger if you wish, by increasing the value of variable B in line 15 to as much as your available memory will allow.

Again, I have used no sound effects or fancy graphics, to make translation of the program into other dialects of Basic easier. The POKEs in lines 15 and 260 change the Vic screen and border colors, and the joystick subroutine at line 1000 is obviously peculiar to Vic. For Pet or Commodore 64, substitute the keyboard subroutine at 1000. For other microcomputers, simply write your own subroutine that returns V=1 for north, V=-1 for south, J=1 for east, J=-1 for west, and R=1 for up or down.

The TI$ in lines 240 and 1005 refers to the built-in real-time clock. This is not a necessary part of the game, but it is interesting to see how long you have been lost! ☐



```
PASSAGES LEAD          00:45
EAST
YOU SEE
A SHOVEL
```

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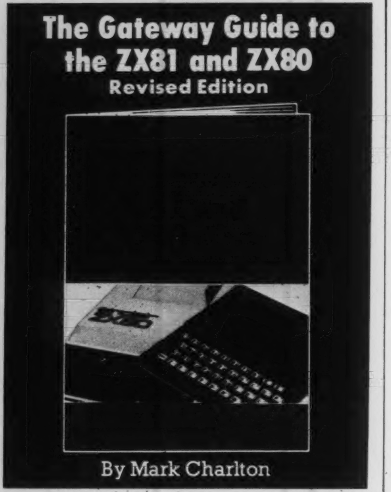

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Cavern Quest, continued...

Cavern Quest for Bally.

```
 1 BC=48;FC=125;CLEAR ;E=10;Z=0;B=300;T=B;C=B/2;FOR A=1TO B+11;@(A)=Z;NEXT A
 2 A=E;@(A)=1;NT=0
 3 D=RND (7);CLEAR ;PRINT T;T=T-1;IF T=0GOTO 24
 4 IFD=2D=-1
 5 IFD=3D=-E
 6 IFD=4D=E
 7 IFD=5D=-C
 8 IFD=6D=C
 9 IFD=7GOTO 18
10 H=A+D;IF H<1GOTO 3
11 IFH>BGOTO 3
12 K=@(H);IF K=3GOTO 3
13 IF K=4GOTO 3
14 IF K>BGOTO 3
15 @(H)=1;IF D=-C@(A)=3;@(H)=4
16 IF D=C@(H)=3;@(A)=4
17 A=H;GOTO 3
18 IF RND (3)#2GOTO 10
19 IF @(A)#1GOTO 3
20 Z=Z+1;K=0;IF Z>EGOTO 3
21 Y=RND (E);K=K+1;IF K=40GOTO 3
22 IF @(Y+B)#0GOTO 21
23 @(A)=Y+B;@(Y+B)=1;GOTO 3
24 @(A)=B+11;CLEAR ;A=E;G=0
25 CLEAR ;IF A#EGOTO 27
26 PRINT "ENTRANCE";IF G=1BC=102;FC=16;PRINT "$$ YOU MADE IT! $$";;NT=2;STOP
27 PRINT "PASSAGES LEAD:";IF A>EIF @(A-E)PRINT"NORTH"
28 IF A<(B-E)IF @(A+E)PRINT "SOUTH"
29 IF @(A-1)PRINT "WEST"
30 IF A<BIF @(A+1)PRINT "EAST"
31 IF @(A)=4PRINT "UP"
32 IF @(A)=3PRINT "DOWN"
33 PRINT ;IF @(A)<BGOTO46
34 PRINT "YOU SEE";X=@(A)-B
35 IF X=1PRINT "A BOOT"
36 IF X=2PRINT "A SKELETON"
37 IF X=3PRINT "A SHOVEL"
38 IF X=4PRINT "MILDEWED SADDLEBAGS"
39 IF X=5PRINT "A RUSTY PISTOL"
40 IF X=6PRINT "A BROKEN LANTERN"
41 IF X=7PRINT "'J. JAMES WAS HERE'"
42 IF X=8PRINT "YUCK! BATS!"
43 IF X=9PRINT "A BUSTED LADDER"
44 IF X=10PRINT "AN EMPTY TRUNK"
45 IF X=11PRINT "$$ TREASURE $$";G=1;@(A)=1
46 V=0;J=0;R=0;J=JX(1);IF J#0GOTO 50
47 V=JY(1);IF V#0GOTO 50
48 R=TR(1);IF R#0GOTO 50
49 GOTO 46
50 IF V=1L=A-E
51 IF V=-1L=A+E
52 IF J=1L=A+1
53 IF J=-1L=A-1                        Put a space
54 IF @(A)=3IF R L=A-C;GOTO56     ←    after the 'R'
55 IF @(A)=4IF R L=A+C            ←    in lines
56 IF L<1GOTO 60                       54 & 55!
57 IF L>BGOTO 60
58 IF @(L)=0GOTO 60
59 A=L;GOTO 25
60 PRINT "***SOLID ROCK***";GOTO 46
```

Cavern Quest for Vic 20, PET/CBM.

```
10 PRINT"J■":POKE36879,72:C=150:E=10:Z=0:B=300:T=B:DIMA%(B+11)
15 PRINT"J CAVERN QUEST"
20 A=E:A%(A)=1
30 D=INT(RND(1)*7)+1:PRINT"■";SPC(13);"     ■■■■■";T:T=T-1:IFT=0THEN240
40 IFD=2THEND=-1
50 IFD=3THEND=-E
60 IFD=4THEND=E
70 IFD=5THEND=-C
80 IFD=6THEND=C
90 IFD=7THEN180
100 H=A+D:IFH<1GOTO30
110 IFH>BTHEN30
120 K=A%(H):IFK=3GOTO30
130 IFK=4GOTO30
140 IFK>BGOTO30
150 A%(H)=1:IFD=-CTHENA%(A)=3:A%(H)=4
160 IFD=CTHENA%(H)=3:A%(A)=4
170 A=H:GOTO30
```

```
180 IFINT(RND(1)*3)+1<>2THEN30
190 IFA%(A)<>1GOTO30
200 Z=Z+1:K=0:IFZ>EGOTO30
210 Y=INT(RND(1)*E)+1
220 IFA%(Y+B)<>0GOTO210
230 A%(A)=Y+B:A%(Y+B)=1:GOTO30
240 A%(A)=B+11:PRINT"J":A=E:G=0:TI$="000000"
250 PRINT"J":IFA<>ETHEN270
260 PRINT" ▨CAVE ENTRANCE■":IFG=1THENPOKE36879,218:PRINT"▨▨$$$  YOU MADE IT!
    $$  $":END
270 PRINT" PASSAGES LEAD":PRINT:IFA>ETHENIFA%(A-E)<>0THENPRINT" NORTH"
280 IFA<(B-E)THENIFA%(A+E)THENPRINT" SOUTH"
290 IFA%(A-1)THENPRINT" WEST"
300 IFA<BTHENIFA%(A+1)THENPRINT" EAST"
310 IFA<(B-C)THENIFA%(A)=4THENPRINT" UP"
320 IFA>CTHENIFA%(A)=3THENPRINT" DOWN"
330 PRINT:IFA%(A)<BGOTO460
340 PRINT" YOU SEE":X=A%(A)-B:PRINT" ";
350 IFX=1THENPRINT"A BOOT"
360 IFX=2THENPRINT"A SKELETON"
370 IFX=3THENPRINT"A SHOVEL"
380 IFX=4THENPRINT"MILDEWED SADDLEBAGS"
390 IFX=5THENPRINT"A RUSTY PISTOL"
400 IFX=6THENPRINT"A BROKEN LANTERN"
410 IFX=7THENPRINT"'J. JAMES WAS HERE'"
420 IFX=8THENPRINT"YUCK! BATS!"
430 IFX=9THENPRINT"A BUSTED LADDER"
440 IFX=10THENPRINT"AN EMPTY TRUNK"
450 IFX=11THENPRINT"▨$$ TREASURE $$$":G=1:A%(A)=1
460 FORDEL=1TO125:NEXTDEL:V=0:J=0:R=0:GOSUB1000
500 IFV=1THENL=A-E
510 IFV=-1THENL=A+E
520 IFJ=1THENL=A+1
530 IFJ=-1THENL=A-1
540 IFA%(A)=3ANDRTHEN:L=A-C:GOTO560
550 IFA%(A)=4ANDRTHENL=A+C
560 IFL<1GOTO600
570 IFL>BGOTO600
580 IFA%(L)=0GOTO600
590 A=L:GOTO250
600 PRINT"▨▨▨▨▨▨▨▨▨▨▨▒▒▒▒SOLID ROCK▒▒▒▒":GOTO460
1000 REM VIC JOYSTICK ROUTINE
1005 PRINT"▨":PRINTSPC(17);MID$(TI$,3,2);":";RIGHT$(TI$,2)
1010 POKE37139,0:POKE37154,127:S3=-((PEEK(37152)AND128)=0):POKE37154,255
1020 PK=PEEK(37137):S1=((PKAND8)=0):S2=((PKAND16)=0):S0=-((PKAND4)=0)
1030 R=-((PKAND32)=0)
1040 V=S0ORS1:J=S2ORS3:IFR=0ANDJ=0ANDV=0THEN1000
1050 RETURN
2000 KT=0
2010 GOSUB1000
2020 IFV=1ORV=-1THEN2030
2025 GOTO2010
2030 IFV=-1THENKT=KT+1
2040 IFV=1THENKT=KT-1
2050 IFKT<1THENKT=B+11
2060 IFKT>B+11THENKT=1
2070 PRINTKT,A%(KT)
2080 GOTO2010
50000 OPEN15,8,15:PRINT#15,"S0:CAVERNVIC":SAVE"0:CAVERNVIC",8:CLOSE15
```

Keyboard subroutine for Pet/CBM or Vic without joystick.

```
1000 REM PET NUMBER KEYPAD ROUTINE
1005 PRINT"▨":PRINTSPC(17);MID$(TI$,3,2);":";RIGHT$(TI$,2):REM PRINT HOME
1010 REM VIC N,S,E,W,U,D KEYS
1020 GETQ$:IFQ$=""THEN1020
1030 J=0:V=0:R=0
1040 IFQ$="4"ORQ$="W"THENJ=-1:RETURN
1050 IFQ$="6"ORQ$="E"THENJ=1:RETURN
1060 IFQ$="8"ORQ$="N"THENV=1:RETURN
1070 IFQ$="2"ORQ$="S"THENV=-1:RETURN
1080 IFQ$="5"ORQ$="U"ORQ$="D"THENR=1:RETURN
1090 GOTO1020
```

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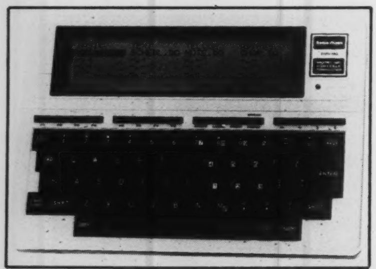
COMPUTERS

TRS-80 MODEL 100

Radio Shack's new TRS-80 Model 100 is a lightweight portable computer that features a full-sized typewriter keyboard with eight programmable function keys, an eight-line, 40-character liquid crystal display, nonvolatile memory and built-in software. The machine will compete in a market that has previously been dominated by the Epson HX-20.

The Model 100 is 2" thick, 8 1/2" tall, less than 12" wide and weighs less than four pounds. It features a nonvolatile memory that maintains information after the machine has been turned off. The processor used is an 8-bit 80C85 CMOS microprocessor. A 300-baud, auto-dial telephone modem is built in, as is the software required to use the modem to connect to the outside world.



Other features include a real-time clock; RS-232, cassette and parallel printer interfaces; four cursor keys; four command keys; and eight function keys. The liquid crystal display can produce both upper and lowercase characters, dot addressable graphics, and a selection of European and graphics characters.

The Model 100 comes with four application programs and a Basic interpreter, all stored in ROM. TELCOM is the built-in communications control program, which features automatic telephone dialing, auto log-on, and both full and half duplex communication. The ADRSS program stores phone numbers and addresses and can be used along with the TELCOM software and the built-in modem to dial phone numbers or log into remote database services. TEXT is a text generation and word processing package that includes search, move, copy, delete, and cut-and-paste commands. The SCHEDL software functions as a personal note pad to help the user keep track of a variety of daily events. All five programs can be accessed from the main menu by positioning the cursor on the desired program and pressing the ENTER key.

The Model 100 will work for 20 hours on four AA batteries or can be powered by an optional AC adapter. Built-in nickel cadmium batteries maintain the contents of memory for up to 30 days.

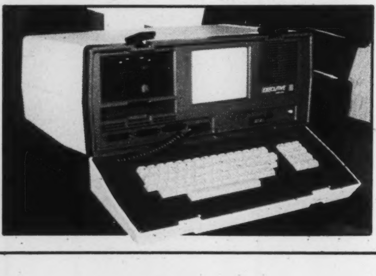
The 8K version of the Model 100 sells for $799. A 24K version is available for $999. Either unit can be expanded to 32K with 8K memory expansion kits selling for $119.95 each. See the August 1983 *Creative Computing* for an in-depth evaluation of the Model 100.

Available at Radio Shack stores and Computer Centers.

TWO PORTABLE COMPUTERS

Osborne has introduced two portable computers. Both units are enhanced versions of Osborne's original product, the Osborne 1. The Executive I is a Z80-based system with a 7" display and two half-height, double density disk drives. The Executive II closely resembles the Executive I with the addition of an Intel 8088 co-processor that provides compatibility with an IBM PC.

The Executive I has much in common with the Osborne 1. The keyboard is identical. Brightness, contrast, and reset controls, external video, and the ten function keys are also unchanged. The two full-height drives of the Osborne 1 have been replaced with two 200K half-height floppy drives. A 7" amber screen is used in place of the 5" black and white screen.



The display format on the Executive I has been enlarged to 24 lines by 80 characters. A composite video output has also been added saving the user the price of an adapter should he wish to attach an external monitor. Five cursor options are provided: invisible cursor, a blinking block, steady block, blinking underline, and steady underline. The character set is read from disk rather than from ROM as on the Osborne 1. This allows the user to adapt the character set to his needs.

Software packaged with the Executive I includes *WordStar, SuperCalc,* CBasic, MBasic and the CP/M Plus operating system. Software written for the Osborne 1 should be compatible with the Executive I with few modifications.

The Executive II includes most of the features of the Executive I with a few additions. The addition of the second processor allows the II to function as either an 8-bit or a 16-bit computer. While operating in 8-bit mode the Executive II should be fully compatible with the Executive I. When operating in 16-bit mode the computer can access and use software written for the 8088 processor. In this mode the system has access to an additional 128K bytes of memory that is entirely independent of the memory accessed by the Z80 processor. In this mode the system can also access the built-in IBM PC compatible video graphics system.

Both of the new machines have been designed with increased communications capabilities. IBM communications protocols supported include 3271, 3780, 2780, and 3741 terminal emulations, and X.25 and SNA network interfaces.

The Executive I is currently available. It sells for $2495 with 128K bytes of memory. The Executive II will be available later in 1983. The price of the Executive II is tentatively set at $3195.

Osborne Computer Corporation, 26538 Danti Ct., Hayward, CA 94545. (415) 887-8080.

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16-BIT COLOR COMPUTER

The chief selling point of the Hitachi MBE1600 computer is its excellent graphics capabilities. The unit boasts 192K bytes of video RAM over and above user memory. The large amount of video storage allows the machine to address each pixel individually in color. This gives the 1600 the ability to present graphics displays in 15 colors with up to 640 by 200 screen resolution.

User memory for the 1600 starts at 128K and is expandable to 384K. Five expansion slots, one occupied by a disk drive, are built into the unit, which currently runs under the MS-DOS operating system. CP/M-86 is expected some time in the future. The unit includes interfaces for color or monochrome display, keyboard, printer, asynchronous communications device, light pen, and a disk drive.

The price for a MBE1600 computer equipped with 128K bytes of user memory, detachable keyboard and choice of color or monochrome monitor starts at $3000.

Hitachi Sales Corporation of America, 401 West Artesia Blvd., Compton, CA 90220. (213) 537-8383.

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EAGLE PERSONAL COMPUTER

The newest member of the Eagle family of microcomputers, the Eagle PC, is the lowest priced Eagle computer introduced to date. Priced from $1995, the PC can be used either as a stand alone personal computer or as an intelligent terminal attached to one of Eagle's 1600 Series computers.

The PC is a desktop system based around an Intel 8088 microprocessor. The main processor cabinet is less than 14" deep and weighs less than 30 pounds. Standard features include two asynchronous serial ports, a parallel port, and 64K bytes of main memory. The computer also comes with a 105-key keyboard that tucks underneath the processor cabinet. The keyboard boasts 24 user-definable special function keys. A monochrome monitor that features 720 by 352 graphics is also included with the system. Available options include memory expansion to 512K bytes, support for either two floppy disk drives or 10 and 32Mb hard disk drives. The Eagle PC is available with either the MS-DOS or CP/M-86 operating system and MicroSoft GW Basic.

The new Eagle PC will be priced from $1995 for a 64K system with a single disk drive. A system equipped with two 320K drives and either MS-DOS or CP/M, Eagle word processing, and Eagle Calc financial planning software will cost $3495.

Eagle Computer, 983 University Ave., Los Gatos, CA 95030. (408) 395-5005.

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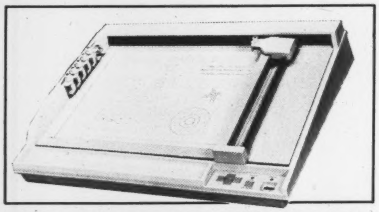
TERMINALS & I/O

SIX-COLOR PLOTTER AND MONITOR

Amplot II, six-color plotter, has been introduced by Amdek Corp. It is compatible with most personal computers and features high pen speed, automatic pen retrieval and .002" resolution.



The microprocessor-intelligent Amplot II receives ASCII commands, and built-in software permits additional alpha-character commands. Eight-bit parallel and RS-232C operation is standard.

Effective plotting range is 10" x 14" and six fiber tip pens are furnished for plotting on ordinary paper or film. $1290.

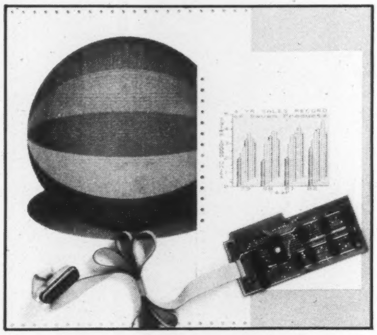
Also available from Amdek is a color monitor, the Color-1 Plus which features a non-glare screen, and a headset for front panel compartment interconnect to the built-in audio amplifier.

Line resolution, 260(H)x300(V), is provided on the 13" CRT. The Color-1 Plus accepts a composite video signal to produce colored graphics or text. $449.

Amdek Corporation, Marketing Department, 2201 Lively Blvd., Elk Grove Village, IL 60007. (312) 364-1180.

CIRCLE 408 ON READER SERVICE CARD

COLOR INTERFACE



Pkaso interfaces include color text and graphics for IDS Color Prism Printers, as well as the Pkaso ID12-Color Interface for the Apple II and Apple III. These include full snapshot dumps of any text or graphics screen image, 16-level gray scale printing, user-created or software-defined printing characters, and SuperRes graphics using the full dot resolution of the printer. Also included are: hi-res and lo-res screen prints, commands to swap and rearrange the color set, commands to change printing colors within word processor text, and commands to create and print with definable sets of colors.

The Pkaso ID12-Color is compatible with Basic, Pascal, and CP/M.

The ID12-Color comes with cable and instructional diskette. ID12-Color Apple II costs $195 and ID12-Color Apple III costs $225.

Interactive Structures Inc., 146 Montgomery Ave., Bala Cynwyd, PA 19004. (215) 667-1713.

CIRCLE 409 ON READER SERVICE CARD

WIDE CARRIAGE PRINTER

Micro Peripherals, Inc. (MPI) announces four new wide carriage versions of the PrintMate 150 printer. PrintMate 150 models offer graphics and font capabilities, optional buffer expansion, and high speed.

PrintMate 150 models A2 and B2 have standard 16K memory buffers. Models A1 and B1 have 4K and 2K buffers respectively.

Models A1 and A2 include the Soft-

Apple 128K RAM Card Sale

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Saturn.........$599*
Alpha Byte...$299*!!

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Alpha Byte's new 128K card for the Apple II, Apple II+, and Apple IIe is now available at this special low price — compare! It comes fully-populated with 128K bytes of RAM and can be configured to execute any software written to run with Saturn Systems' or Legend Industries' 128K RAM cards. Visicalc™ expansion and disk emulation software are standard and the board comes with a full 2 year no hassle warranty.

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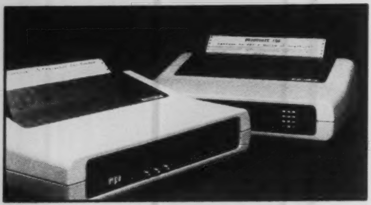
CIRCLE 287 ON READER SERVICE CARD



Switch front panel keypad for direct control of forms length, print density, horizontal and vertical tabs, baud rate, and character set.

Applications packages called Ap-Paks are designed to enable most microcomputers, with the PrintMate 150, to produce various type styles and graphics. Prices of printers start at $995.

Micro Peripherals, Inc., 4426 South Century Dr., Salt Lake City, Utah 84107. (800) 821-8848.

CIRCLE 410 ON READER SERVICE CARD

TELERAY TERMINAL

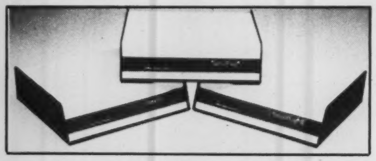
Teleray has introduced the Model 16 terminal.

Features include a user-definable keyboard and memory format; a four-function calculator; a clock that displays either time of day or elapsed time on the 25th line; four pages of display memory (optionally up to eight pages, non-volatile); two bi-directional, buffered communications ports; and ANSI X3.64-compatibility. $1610.

Teleray, Box 24064, Minneapolis, MN 55424. (612) 941-3300.

CIRCLE 411 ON READER SERVICE CARD

TELEX INTERFACE



Teleface Corp. has introduced TelexPlug, a device that gives word processors and computers access to TWX and Telex.

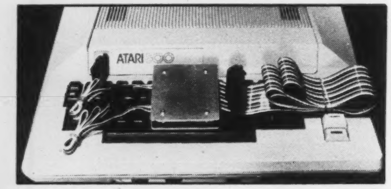
TelexPlug connects any computer or word processor with the Western Union telex network, as well as other common carriers, so that users may send and receive messages directly through their word processor or computer.

When the word processor or computer is unattended, or involved with other tasks, and the unit senses an incoming message, it will automatically store the message, or route it to the printer. $1485.

Teleface Corp., GPO Box 2238, New York, NY 10116. (212) 477-6802.

CIRCLE 412 ON READER SERVICE CARD

PRINTER INTERFACE



Interface No. 1 by Looking Glass Microproducts allows you to connect any printer with a Centronics compatible parallel interface (Anadex, C. Itoh, Epson, Microline, Okidata, etc.) to an Atari 400 or Atari 800 Personal Computer System via Controller Jacks J3 and J4.

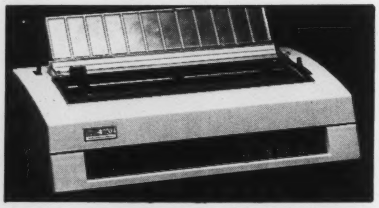
A printer handler is provided on cassette or diskette. This handler replaces the resident printer handler, occupies less than 128 bytes of user program area, and is compatible with all Atari cartridges and programs.

Interface No. 1 comes with full documentation, step-by-step installation instructions, and complete program listings. $85.

Looking Glass Microproducts, P.O. Box 5084, Loveland, CO 80537.

CIRCLE 413 ON READER SERVICE CARD

DAISYWHEEL PRINTER



Data Terminals and Communications has introduced a daisy wheel printer, the DTC 380Z for the personal computer user.

The specification includes a 48,000 character buffer memory, allowing the computer to load the printer memory within a few seconds, then be used for further applications while the 380Z prints at up to 32 characters per second. Interconnecting cables are available to enable the DTC 380Z to work with most personal computers, including Osborne, IBM, Apple and TRS-80.

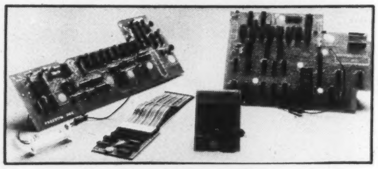
Other features are full bi-directional printing, automatic proportional spacing, serial and parallel interfaces, software compatibity with the Diablo 1640/1650/630, graphic plotting, 50 to 19.2K baud, and a momentary pause capability for paper, printwheel and ribbon changing. The printwheel is available in 12 different print styles and works with standard ribbons. $1199.

Data Terminals and Communications, 590 Division St., Campbell, CA 95008. (408) 378-1112.

CIRCLE 414 ON READER SERVICE CARD

CONVERSION BOARDS FOR TRS-80

The Freedom Option and Freedom Plus Boards allow the TRS-80 Models I and III, the PMC 80 and 81, and the LNW 80 to run CP/M applications software as well as TRSDOS software. The Freedom Option is the basic CP/M conversion board while the Freedom Plus provides CP/M conversion and adds 16K of RAM to the TRS-80.



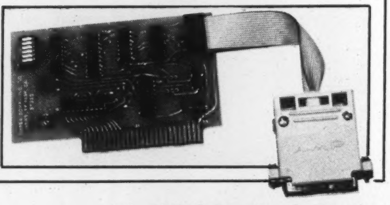
The Freedom Boards include the CP/M compatible operating system, T8/OS, which can run with any combination of 5 1/4 and 8 inch drives, single or double density, single or double sided. Freedom Option is $275 and Freedom Plus is $490.

Freedom Technology International, 119 North 18th Street, Philadelphia, PA 19103. (215) 569-2381.

CIRCLE 415 ON READER SERVICE CARD

SERIAL INTERFACE FOR APPLE

Versa Computing, Inc., announces a serial interface for Apple II computers. The Versa serial interface has been designed to function only with those features necessary to operate a serial printer. It operates with the RS-232C protocol and other configurations can also be accommodated at installation times.



Discover the hidden power of your TS 1000 and ZX-81

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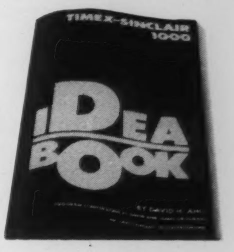

If you suspect you're not getting all you can from your Timex Sinclair 1000, here's a new book that will make sure you do.

David H. Ahl has written 16 books about computers. In **The Timex Sinclair 1000 IdeaBook** he puts 25 years of experience to work—to help you put your computer to work.

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New Products, continued...

The interface operates at switchable baud rates of 300, 600, 1200, 1800, 2400, 4800, 9600 and 19,200. In addition to baud rate the printer is equipped with switches for automatic line feed, screen display and line length. The interface package contains a 4.5"x2.7" printed circuit board, a ribbon cable with eight female pins crimped on one end, and a 16 pin dip header on the other. The crimped pins are installed into the female connector to interface it to a particular printer. $79.95.

Versa Computing, Inc., 3541 Old Conejo Rd., Suite 104, Newbury Park, CA 91320. (805) 498-1956.

CIRCLE 416 ON READER SERVICE CARD

PASCAL SUPER SYSTEM

Legend Industries Ltd. announces the availability of the Pascal Super System for the Apple II. This system supports the simulation of fast access disk drive units for storage and retrieval of standard Apple Pascal files with the added speed of the 6809 Stellation Mill.

The system contains Legend 128KDE RAM card, Stellation Two 6809 Mill, and Super1: diskette.

The Super1: diskette is software designed as a Pascal Disk Emulator with patch routines to run a 128K emulated disk drive with a 6809 processor card. The 6809 or 128KDE can also be used separately.

Both the Legend 128KDE RAM card and the Stellation Two 6809 Mill plug easily into any I/O port on the Apple II motherboard except slots 3 and 6.

Legend Industries, Ltd., 2220 Scott Lake Rd., Pontiac, MI 48054 or Stellation Two, P.O. Box 2342, Santa Barbara, CA 93120.

CIRCLE 417 ON READER SERVICE CARD

LOW COST TERMINALS

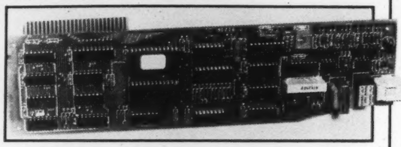
The ZTX-10 and ZTX-11 are menu-oriented, DEC VT-53 compatible, ASCII computer terminals. Each weighs less than four pounds and is housed within a seven by fifteen inch casing. Both can be programmed to remember up to 26 names and telephone numbers.

The ZTX-10 terminal costs $399. It includes a 63-key keyboard and both an RS-232 and a Centronics interface. The ZTX-11 retails for $479. It boasts all the features of the lower priced machine, plus the addition of a built-in, auto-dial, auto-answer, 300 band modem.

Zenith Data Systems, 1000 Milwaukee Ave., Glenview, IL 60025. (312) 391-8744.

CIRCLE 418 ON READER SERVICE CARD

MODEM FOR APPLE



SSM Microcomputer Products has announced a 110/300 baud full duplex modem for the Apple II.

The SSM Apple ModemCard features half and full duplex, auto answer/auto dial, Touch Tone and pulse dialing, and audio monitoring to provide increased flexibility for use with many systems, including PBX. The ModemCard plugs directly into any Apple slot (except 0) and requires no additional external devices. $299.

SSM Microcomputer Products Inc., 2190 Paragon Dr., San Jose, CA 95131. (408) 946-7400.

CIRCLE 419 ON READER SERVICE CARD

CASSETTE INTERFACE FOR COMMODORE

The Vik-Dubber cassette interface allows Commodore 64 and Vic users to save and load data using a standard cassette recorder. The product also allows two cassette recorders to be connected to make backup copies of programs. The

PROGRAMS $1-EACH

NEW!! The Apple users group software library bonanza at truly affordable prices. For the first time enjoy your Apple to its fullest capacity using specially packed disks with over **60 outstanding programs each.** Not available from any other source!

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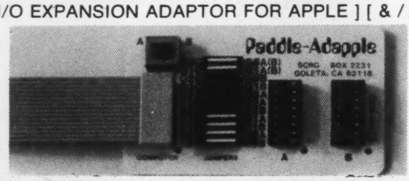
CIRCLE 115 ON READER SERVICE CARD

Paddle-Adapple

I/O EXPANSION ADAPTOR FOR APPLE] [& / /e



• Works with all Apple compatible joysticks and paddles • Unique "Jumpers" socket allows you to configure to meet your needs • Select one of two devices or use 4 paddles simultaneously • Gives you four pushbutton inputs • Supports shift key modification • Exchange X & Y joystick axis • Small & compact—adheres to computer with supplied foam tape • All strobes, annunciators and power available on both connectors. **$29.95**

Paddle-Adapple 'D'

Same as the PADDLE-ADAPPLE that we all know and love, except it has two subminiature 'D' connectors. These are used on the new paddles and joysticks for use with the APPLE / /e. It also permits the new style paddles and joysticks to be used with the APPLE] [and] [+. **$29.95**

Paddle-Adapple Combo

Again, the same PADDLE-ADAPPLE except it has one 16 pin socket, and one subminiature 'D' socket. **$29.95**

These fine products come with a 90 day warranty
Available at your local dealer or direct from:
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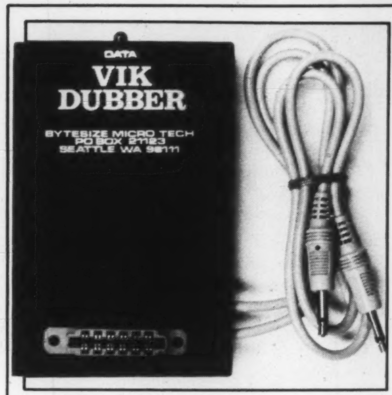
Add $2.50 for shipping, $5.00 outside U.S.A. & Canada. CA add tax.

Apple is a trademark of Apple Computers

CIRCLE 256 ON READER SERVICE CARD



Vik-Dubber plugs directly into and derives its power from the computer. $34.95.

Bytesize Micro Technology, P.O. Box 21123, Seattle, WA 98111. (800) 227-3000.

CIRCLE 420 ON READER SERVICE CARD

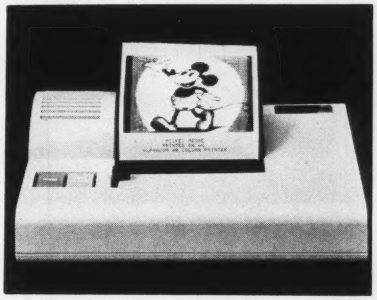
VOICE INPUT MODULE FOR APPLE

The MCE Voice Input Module (VIM) can be programmed to recognize an 80-word or phrase vocabulary with up to 98 percent accuracy. With proper use the package provides voice control of software, and allows for simultaneous input of data by voice and keyboard. Vocabularies for Basic, *VisiCalc, WordStar,* and *Magic Window* are predefined in the software.

MCE Inc., 157 South Kalamazoo Mall, Kalamazoo, MI 49007. (800) 421-4157.

CIRCLE 421 ON READER SERVICE CARD

LOW COST 40-COLUMN PRINTER



The Alphacom 42 is a 40-column, thermal printer that can print up to two lines per second. It prints both upper- and lowercase letters and features a wraparound facility that allows printing of text lines longer than 40 characters. Alphacom also sells the cables required to interface the cartridge-like interface on the printer to the Vic 20, Commodore 64, Atari or Texas Instruments home computers.

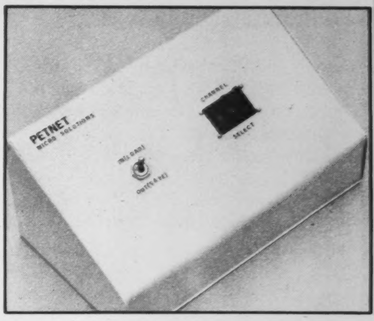
The Alphacom 42 retails for $179.95. Interface cables start at $29.95.

Alphacom Inc., 2323 South Bascom Ave., Campbell, CA 95008. (408) 559-8000.

CIRCLE 422 ON READER SERVICE CARD

NETWORK CONTROLLER FOR PET

Petnet is a network controller designed to be used with the Commodore Pet series of microcomputers. All computer stations may be loaded simultaneously from the master computer using the master disk or cassette unit, and vice versa.



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CIRCLE 237 ON READER SERVICE CARD

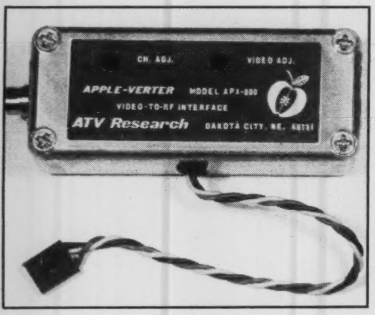
New Products, continued...

Petnet includes plug-in installation; compatibility with all Pets including Vic 20; no interference with normal operation of communication ports (cassette, parallel, IEEE); and no supporting software. $695.

Micro Solutions, P.O. Box 25291, Tempe, AZ 85282. (602) 831-6433.

CIRCLE 423 ON READER SERVICE CARD

APPLE-VERTER MODEL APX-800



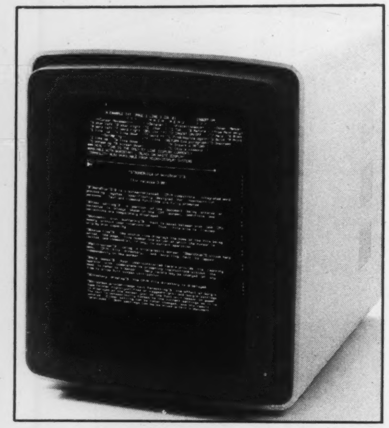
ATV Research has announced a color video modulator, the Apple-Verter, Model APX-800. It is high VHF-band, tunable modulator, for the Apple II. It includes a 10' direct-connect antenna cable. A built-in 5V regulator allows the modulator to be used on other computer systems with power sources anywhere between 8 and 24VDC. $29.75.

ATV Research, New Product Sales, 13th & Broadway, Dakota City, NE 68731. (402) 987-3771.

CIRCLE 424 ON READER SERVICE CARD

CRT INTERFACES

Micro Display Systems, Inc. has announced three compatible interfaces for The Genius full page display CRT: RS-232, S-100 and Apple III versions.



The Genius displays an optional 57 or 73 lines of text by 80 characters across. It is used for office automation, applying to word processing, data processing and software development. It is compatible with WordStar (with SoftCard), and other CP/M based software programs. It has an 87 MHz bandwidth and 8K bytes of high-speed buffer memory. An Apple II interface card is standard with the Genius. $1,795.

Micro Display Systems, Inc., 1310 Vermillion St., P.O. Box 455, Hastings, MN 55033. (612) 437-2233.

CIRCLE 425 ON READER SERVICE CARD

PRINTER INTERFACE FOR COMMODORE

Xitel Inc. announces the Model CX-6401 interface which allows the Commodore 64 or Vic 20 computer to use any type of standard commercially available parallel interface printer. The interface connects to the serial port/bus on the computer, not the user port, allowing the user port to remain open for us by a modem or RS-232C peripheral device. The CX-6401 features elimination of the hand shaking problem of RS-232C cartridge, mode switch to correct ASCII problem, no RS-232C cable, the use of parallel

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NOISE FILTER & SURGE SUPPRESSOR
TRIPP LITE

ISOBAR...
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More features to prevent errors, false printout, disc skips! *Only ISOBAR has 3-way spike protection, noise suppression for RFI PLUS isolated filter banks!* Individual filter banks isolate each load from other loads minimizing data errors of *any* kind. MOV surge suppressors arrest both common mode and differential mode surges. L/C filter network rejects radio frequency noise at any amplitude. Torroidal coils for greatest efficiency! All-metal housing.

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Model IBAR 4-6 (4 outlets, 6 ft. cord) **Only $79.95**

Model IBAR 3-6 (3 outlets, 6 ft. cord) **Only $54.95**

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CIRCLE 179 ON READER SERVICE CARD

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ISO-11 2 Double Isolated Banks, 6 Sockets	115.95
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ISO-17 4 Quad Isolated Sockets	200.95
ISO-18 2 Quad Isolated Banks, 6 Sockets	169.95
Circuit Breaker, any model (Add-CB)	Add 10.00
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CIRCLE 172 ON READER SERVICE CARD

type printers, multiple printers, and unused user port lines available for external usage.

The CX-6401 comes standard with a 6-foot serial bus cable and connector for direct connection to the Commodore 64 or Vic 20. In addition the CX-6401 has a 1-foot parallel cable for connection to the printer. $89.95.

Xitel Inc., 2678 North Main St. #1, Walnut Creek, CA 94596. (415) 944-9277.

CIRCLE 426 ON READER SERVICE CARD

It is compatible with Disk II mini and SVA 8" floppy drives, as well as a micro programmed controller that plugs into any slot, and eliminates the need for additional hardware.

Sorrento Valley Associates, Inc., 11722 Sorrento Valley Rd., San Diego, CA 92121. (714) 452-0101.

CIRCLE 428 ON READER SERVICE CARD

ATARI DISK DRIVE

Percom Data Corporation has released a new disk drive system for the Atari computer line.

The Percom Data AT-88 is compatible with both the Atari 400 and 800 models.

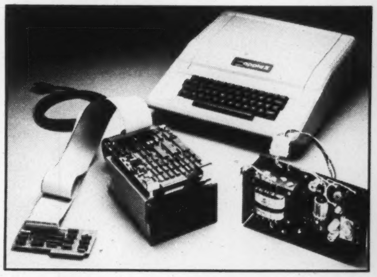
It is a single density drive, offering 88 Kbytes (formatted), plug-in compatibility to Atari computers, and its own integral power supply. It is shipped with the OSA/Plus operating system. The Percom Data drive may also use the Atari operating system software without any modification.

Percom Data Company, Inc., 11220 Pagemill Road, Dallas, TX 75243. (214) 340-7081.

CIRCLE 429 ON READER SERVICE CARD

DISK SYSTEMS

HARD DISK SYSTEM FOR APPLE II



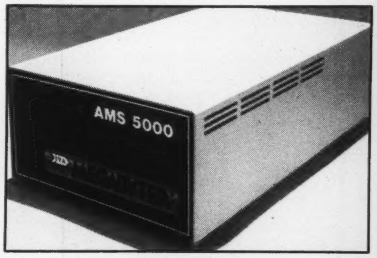
A 5-megabyte Winchester disk system package for Apple II microcomputers has been introduced by Xebec. It is a kit aimed at the home/hobbyist market and system integrators.

The 5 megabyte hard disk system features up to 22-bit error detection and up to 11-bit error correction, a full sector data buffer, and single command disk initialization. The total cost is $1,299.

Xebec, 432 Lakeside Drive, Sunnyvale, CA 94086. (408) 735-1340.

CIRCLE 427 ON READER SERVICE CARD

APPLE II HARD DISK SYSTEM



SVA announces the AMS 5000 Megabyter Hard Disk System adding up to 20 megabytes of on-line data storage for the Apple II.

Using Winchester technology, the AMS 5000 can be used for standard DOS, Pascal and CP/M based operating systems.

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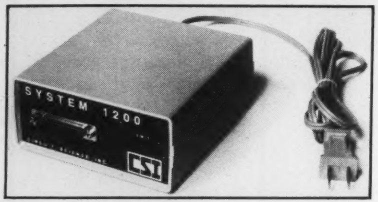
CIRCLE 282 ON READER SERVICE CARD

New Products, continued...

PERIPHERALS

REMOTE CONTROL INTERFACE



An electric circuit remote control unit that interfaces with personal and small business computer systems has been introduced by Circuit Science, Inc.

The Circuit Science CSI-1200 Electric Appliance Controller features a serial RS-232 interface that allows computer control of up to 256 lights, wall switches, and appliances. Compatible with Apple, TRS-80, IBM, Atari, Osborne, Commodore and any computer with a serial interface, it operates with BSR X10 remote modules to help save energy and provide added security. $169.

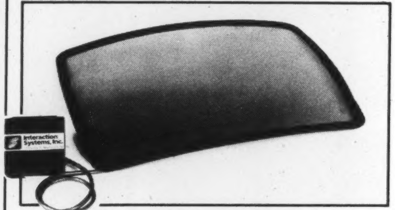
Circuit Science, Inc., 3 Four Townsend West, Nashau, NH, 03063. (603) 880-4066.

CIRCLE 430 ON READER SERVICE CARD

TOUCH SENSOR

Interaction Systems, Inc. has developed a new method of detecting the touch of a human finger on the face of a CRT display. The new method utilizes an unpatterned tempered coated glass faceplate which overlays the CRT monitor. Touch detection is accomplished through the sensing of impedance changes resulting from the touch of the finger.

The touch detector provides the "X" and "Y" coordinates of the point which was touched in an 8-bit numeric output (0 through 255) for each of the two dimensions.



A keyboard can be displayed on a video monitor to enable a person to "type" directly on the screen. Alternatively, a person can draw the shapes of letters directly on the screen and have them be recognized by the computer.

In electronic games, instead of using keyswitch controls, the user can directly touch game icons displayed on the video monitor. Rolling the finger on the icons can replace the joystick to direct movements of objects in the game. Price to OEM's, about $200.

OEM Marketing, Interaction Systems, Inc., 24 Munroe Street, Newtonville, MA 02160. (617) 964-7000.

CIRCLE 431 ON READER SERVICE CARD

SOFTWARE

GRAPHICS

ES Painter allows anyone who owns an IBM PC to try his hand at being an artist. When using the program, the color monitor becomes a drawing board. The program runs on an IBM PC with 64K bytes of memory, disk drive, color graphics card, joystick, and game adapter. $45. E & S Software Services, P.O. Box 238, Bedford, MA 01730. (617) 275-8534.

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CIRCLE 230 ON READER SERVICE CARD

EDUCATIONAL

In Search Of The Most Amazing Thing is a combination adventure, strategy and arcade game designed for children from ages 10 to 90. Skills used in the game include decision making, note-taking, writing, map reading, trading, music-writing and drawing. The program is available for Apple, Atari, IBM and Commodore 64 computers. $39.95. Spinnaker Software, 215 First St., Cambridge, MA 02142. (617) 868-4700.

CIRCLE 433 ON READER SERVICE CARD

The **Radio Shack Color Author** courseware authoring system allows teachers to create instructional materials for use on a 32K Color Computer with disk drives. The system is menu-driven, guiding the instructor through the frame by frame creation of individual study plans. Available at Radio Shack stores and Computer Centers.

BUSINESS

The Microsoft Multi-Tool expert systems are a set of business management productivity tools that help the user analyze financial data. Each expert system includes a set of pre-programmed templates that are used to customize Microsoft's *Multiplan* spreadsheet package for specific financial or accounting applications.

The *Budget* expert system is appropriate for retailers or manufacturers who require an operating budget planning and control system. The *Financial Statement* expert system will be of interest to business managers, sophisticated individual investors, and people in the financial service industries such as stock brokers, investment analysts, and management consultants. The Budget expert system retails for $150, while the Financial Statement expert system is priced at $100.

The *Multi-Tool* expert systems run on any MS-DOS system with 128K bytes of memory and one disk drive or on an Apple II with 64K bytes of memory and at least one disk drive. Microsoft Corporation, 10700 Northup Way, Bellevue, WA 98004. (206) 828-8080.

CIRCLE 434 ON READER SERVICE CARD

WORD PROCESSING

Wordcraft 20 is a word processing program for the Vic 20. It comes in a cartridge that houses the 16K program and 8K of RAM memory that can be used for word processing or for Basic programming. Features include variable page widths and lengths, automatic page centering, justified or ragged margins, text highlighting, tab stops, decimal tabs and a page capacity of 66-lines of 99 characters. $230. United Microware Industries, Inc., 3503-C Temple Ave., Pomona, CA 91768. (714) 594-1351.

CIRCLE 435 ON READER SERVICE CARD

PERSONAL

Super SST is a spreadsheet program for the Sharp PC-1500 and Radio Shack PC-2 pocket computers. Written in machine language the program is provided on a cassette tape. The program requires an 8K expansion module and a cassette interface. $49.95. The Pocket Computer Newsletter, P.O. Box 232, Seymour, CT 06483. (203) 888-1946.

CIRCLE 436 ON READER SERVICE CARD

CPAids has announced **Tax Planner**, a year-round personal tax planning program. It is based on user-definable tax tables beginning with 1982 and computes tax schedules plus Schedules G, 4625, 4972, 6251 and sales tax tables. Up to four different assumption data files for a given year and tax calculations for four different years can be programmed. A depreciation program is also included. The package is compatible with any system which has CP/M or MP/M, 64K of RAM, an 80 x 24 screen and an 80-column printer, including the IBM PC and Apple II. $300. CPAids, 1061 Fraternity Circle, Kent, OH 44240. (216) 678-9015.

CIRCLE 437 ON READER SERVICE CARD

SCRG PRESENTS

For Your Apple] [, Apple] [+, Apple / /e, Apple / / / & Franklin

switch-a-slot

disk II
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CIRCLE 257 ON READER SERVICE CARD

The Sketch Pad

Tom and Kelda Riley

The capacity of the Apple and other home computers to produce complex graphics gives us an exciting new artistic medium, but one which is often difficult to use. There are several commercial software packages that simplify entering images into the computer, but the lack of suitable drawing instruments limits their use. Graphics paddles and graphics tablets are currently on the market, but the cost of this hardware is prohibitive for many would-be computer artists.

If you are interested in experimenting with computer graphics but can't spend much money on hardware, consider building this versatile sketch pad which will let you draw directly into the high resolution graphics screen. We will show you how to construct the sketch pad for a total cost of about $30.

Features of the Device

The sketch pad has a drawing surface slightly larger than a standard sheet of paper (8½ × 11 inches). You can attach drawings and photographs to the pad and trace them into the hi-res screen, or you can use a blank sheet of paper and draw simultaneously on the paper and the screen. You can also use the sketch pad to read graphs, strip charts, and business charts directly into the computer.

Figure 1 is a drawing of the finished device. Features to note are the baseboard, the upright post which can be adjusted to change scale, the head with its two potentiometers, the cantilever, the pencil holder, and the cable with a box for the pushbuttons.

The unit is constructed of plywood and sheet metal and can easily be made in a home workshop or shop class. It could be built completely with hand tools, but the use of a table or radial arm saw speeds up the job. The wiring is extremely simple, so the electronics work shouldn't intimidate an interested builder. All in all, this is a good beginner's project.

We have included three programs in Applesoft Basic to give you a start in using the sketch pad. Listing 1 is a linearity test program that shows how well this sketch pad or any commercial graphics unit is working. Listing 2 lets you draw directly onto the hi-res graphics screen in three different modes, store pictures to the disk, and then retrieve them. Listing 3 is a program that lets you measure points on data sheets and enter them into your computer for data analysis, a process called digitizing the data. The sketch pad will digitize

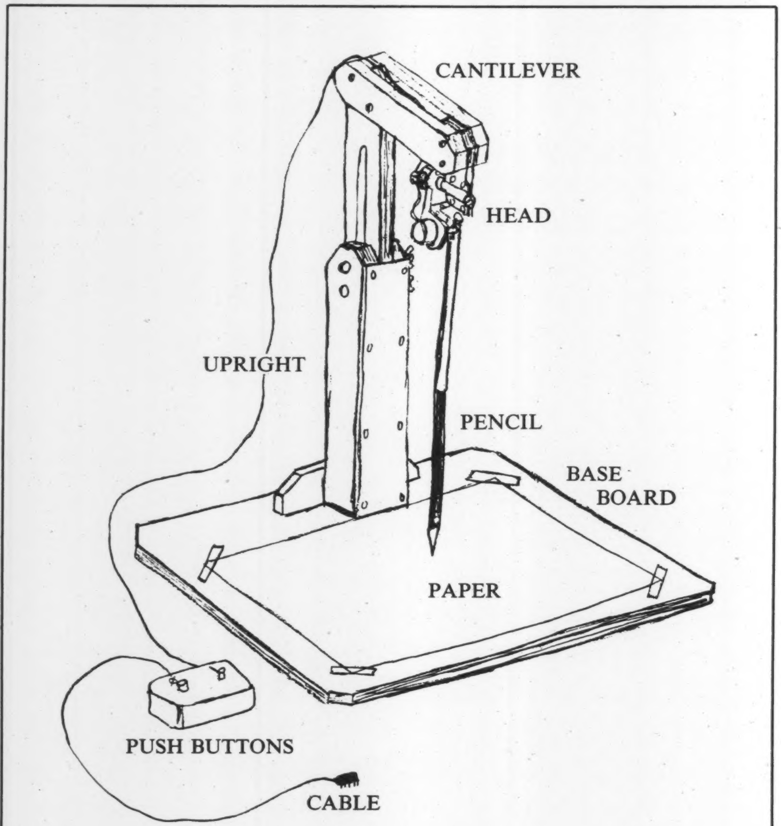

Figure 1. Sketch Pad.

Tom and Kelda Riley, 1002 Lewis Ave., Rockville, MD 20851.

quickly and with reasonable accuracy, and this program will store and retrieve the data from disk as well. We will examine all of these programs in detail later in the article.

Precision and Linearity

Simple game controllers can be rather sloppy devices, since accuracy is often sacrificed for speed and feel. But in constructing a sketch pad, you want all the precision you can get. Two parameters are important in obtaining that precision.

First is the theoretical precision of the electronic circuits, whether they are 8-bit, 10-bit, or greater. Second is the uniformity or linearity of the mechanical to electrical converters, in this case the potentiometers. These considerations arise whenever you are continuously changing quantities (analog) to numbers (digital) or vice versa.

The paddle input on the Apple II and most other home computers is a timer circuit which converts a resistance value into a number between 0 and 255. This is an inexpensive and stable 8-bit analog to digital (A to D) converter. It is also an extremely slow one. The best possible precision it can have is one part in 256, or about 0.57. This sounds pretty good; old style panel meters had an accuracy of about 5% at best.

The problem with even 0.5% precision is that errors creep in because of aging components and temperature changes, so the theoretical precision is rarely achieved. And, if you have to measure several numbers and use them in mathematical equations, the inaccu-

Parts List

Number Required	Description of Part	Suggested Supplier	Total Cost
3	CMU1052 linear taper pot, 1 Meg, Mil Spec	Jameco	$9.00
1	16-pin DIP header	Jameco	.70
2	Pushbuttons, #275-609	Radio Shack	1.90
1	Box, #270-230	Radio Shack	1.90
12 ft.	Telephone cable, #278-365	Radio Shack	3.00
2	Resistors, 1K, ¼ watt	Radio Shack	.40
2 sq. ft.	Plywood, ½" hardwood preferred		4.00
1 sq. ft.	Sheetmetal, aluminum or steel		1.00
2	Bolts, ¼ x 2"		.60
2	Wing nuts, ¼"		.30
2	Flat washers, ¼"		.10
16	Flathead wood screws, #6 x ½"		.60
10	Flathead wood screws, #8 x 1"		.60
3	Bolts with lockwashers and nuts, #6 x ½"		.40
2	Bolts with nuts, #8 x 1¾"		.30
6	Pop rivets, ⅛ x 3/16"		.40
1	Brass tube (to fit pencil)	Hobby shop	.60
Misc.	Cotton felt, sandpaper, varnish, etc.		2.50
		Approximate total	$28.00

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Controller Corner, continued...

racies tend to add up. Expensive computer systems usually have 10- or 12-bit A to D converters. (The most accurate converter we have seen is a 24-bit system in an astronomical observatory.) The more precision you try for, the more difficult it is to calibrate and stabilize the system so that you can approach its theoretical limit.

The second problem is linearity. For the sketch pad, linearity defines how straight a line it will draw. The electronic timer circuit has strikingly good linearity, but the potentiometers do not. If we draw a graph of the resistance of a pot versus the degree of turn of the pot shaft, we should get a straight line. But if the manufacturing processes for the resistive element in the pot, are not extremely uniform, the measured reading will vary from the ideal straight line. If you use cheap, non-linear pots in the sketch pad, the lines you draw with it will be bent. Your drawings will look like the reflections in a funhouse mirror.

There is not much you can do to increase the precision of the 8-bit Apple digitizer, at least not cheaply. But eight bits is almost enough for Apple graphics, anyway. The resolution of the hi-res screen is 280 by 192 picture elements, and the two paddles resolve 256 by 256. This is more than enough precision vertically, and we are only short by 8% horizontally.

Construction of the Unit

Figure 2 gives a top view of the baseboard and details of other wooden parts. The first step in constructing the sketch

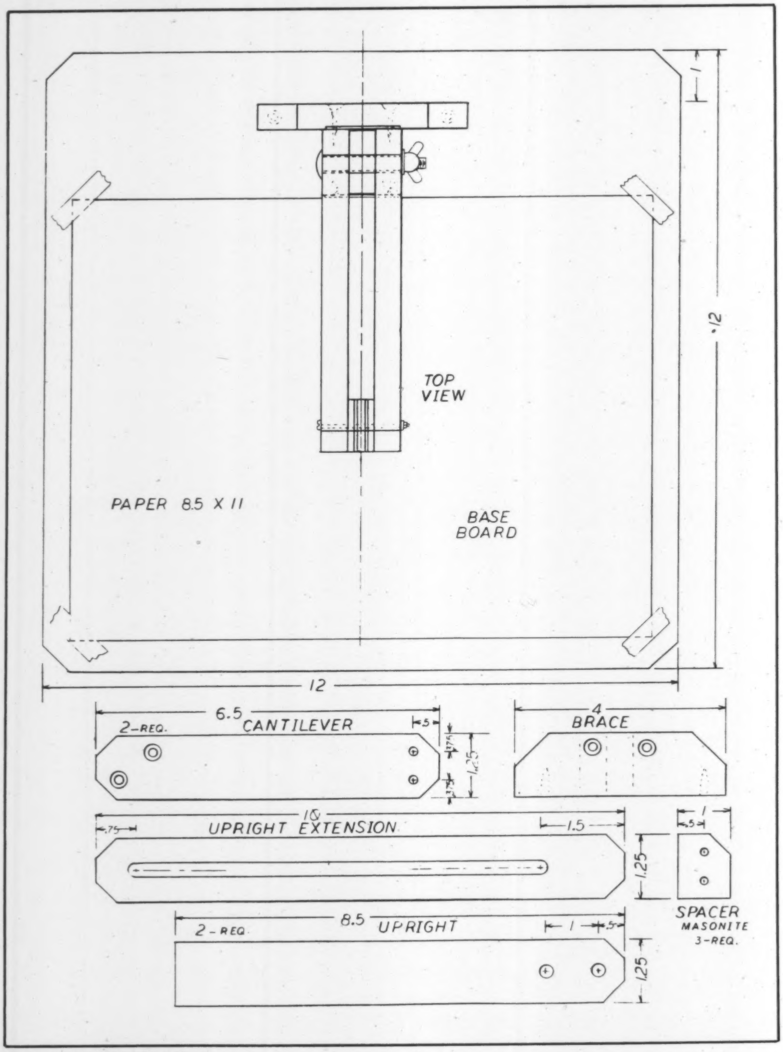

Figure 2. Wooden Parts.

pad is to gather all the materials and cut out the parts.

The prototype was made from ½" hardwood plywood (part of a salvaged kitchen cabinet), but standard fir plywood would work as well. The drawing surface of the baseboard must be sanded smooth. The wooden parts of the uprights and cantilever were cut from the same plywood and also had to be well-sanded, particularly along the edges. Most of the holes shown in Figure 1 are for #8 × 1" wood screws. They were drilled with a Screw Mate drill, which produces exactly the right shape hole and countersink.

Most of the metal parts (see Figure 3) were cut from a 1/16" thick piece of aluminum scrap. Galvanized steel about 1/32" thick would also give good results. You must be able to work the material with hand shears, but it can't be so flimsy that the parts are easily bent. When you are drilling sheet metal, you should hold it with vise-grip pliers or in a bench vise to keep it from spinning and cutting your hand. The front and back of the upright have countersunk holes for #6 flathead wood screws. File all edges and corners smooth as soon as you cut or drill them.

The parts for the head, which holds the two pots, are somewhat complicated; Figure 4 shows them in detail. It helps if you have your pots in hand so you can trial-fit them. If your first attempt doesn't look right, make another.

Cut out the two metal pieces that form the hanger, as shown in Figure 3, then drill only the two central pop rivet holes. Pop rivet the pieces together. Now open up the bottom parts of the hanger and bend them around a ¼" bolt to form the pot shaft clamp. Bend back the bottom tabs so that they don't quite touch. With the bolt still in place (it substitutes for the pot shaft), drill the clamp bolt holes for the bottom shaft. Drill the top bolt holes. Then, using this metal piece as a pattern, drill the matching holes in the cantilever parts and the masonite spacers.

Cut out the pot mount piece and brace, file the edges smooth, and drill the holes for the pots. You will need a hacksaw for the two small cuts. Use the pots to mark the positions of the spin prevention tab holes. Now bend the pot mount to look like the one in Figure 4. For the prototype, the metal was bent in a bench vise with custom-made oak jaw faces. Fit the brace in position and clamp it with vise grip pliers in order to drill the pop rivet holes. Install each pop rivet after its hole is drilled, working from the outside to the inside.

The holder for the drawing instrument is made from brass tubing available at your local hobby shop. You may want to make several different size holders for pencils, pens, and a plain wooden pointer or stylus. Be sure to take the instruments to the hobby shop with you for trial fittings. Cut the brass tubing with a small triangular file. If the fit is a little loose you can insert a ⅜" strip of heavy polyethylene sheet (a garbage bag is a good source) inside the tube. You may have to cut the erasers off pencils.

Next, cut a 1¼" wood plug from ⅜" maple dowel to fit inside the top of the tube and glue it in place with epoxy. After the glue has completely set (preferably overnight), drill the pot shaft hole, the bolt hole, and the saw cleft stop hole. Make the saw cleft with a hacksaw and file all edges smooth.

Put together the wood parts with wood screws and carpenter's glue and then fit and mount the metal parts. Install the clamping bolts, but leave them loose; the upright extension should slip smoothly into the upright. You may have to sand and rasp the extension some more to get a smooth adjustment.

When everything fits, take off the metal parts and fine sand the wood. All wood parts should be finished with two or three coats of satin-finish polyurethane varnish. When the varnish is

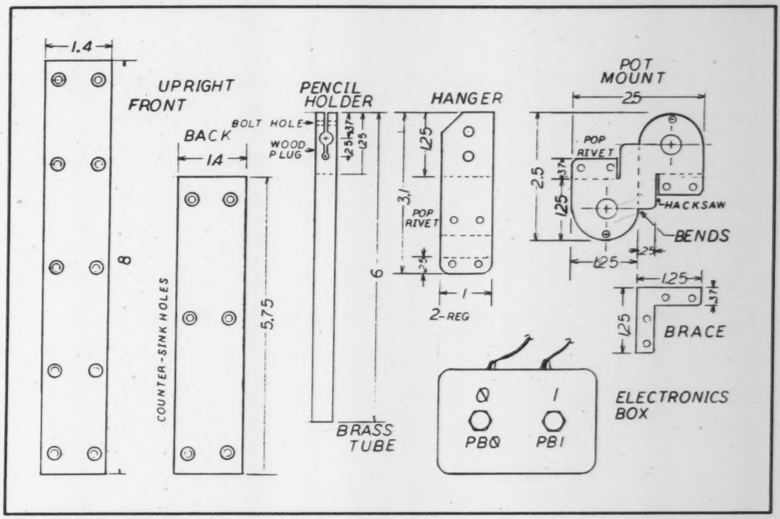

Figure 3. Metal Parts.

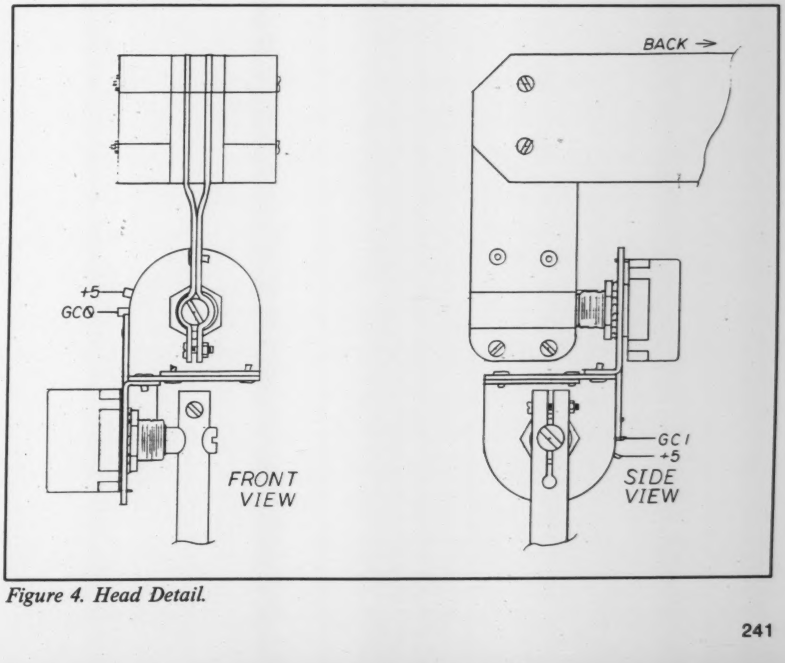

Figure 4. Head Detail.

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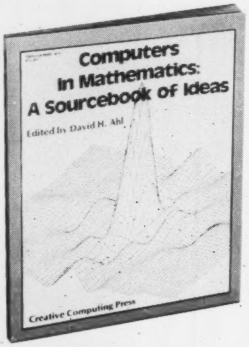

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Controller Corner, continued...

thoroughly dry, reassemble the entire device.

To prevent the sketch pad from scratching your furniture, you can glue cotton felt to the bottom of the baseboard with contact cement. To make a better surface to work on than the finished wood, attach a heavy piece of drawing paper to the unit with drafting tape.

Electrical Components

The utility of the sketch pad is dependent on good potentiometers; the pots must be as linear as possible. We have had good luck with the pots that meet military specifications (mil spec) described in the parts list, but even with these you should consider buying a few extras so you can choose the ones that draw the straightest lines. The pots listed have short shafts; they are just long enough for the homemade clamps. If you have a choice, get long-shafted pots and saw off the shafts as needed.

The pots do not travel through their full turning of 300 degrees, so you will

Listing 1.

```
10  REM  ***********************
12  REM  *
14  REM  *  LINEARITY TEST
16  REM  *
18  REM  * TOM RILEY COPYRIGHT 83

20  REM  *
22  REM  ***********************
24  REM
30  DIM X(5),Y(5)
50  FOR N = 0 TO 4
55 X(N) = 255 * N / 4:Y(N) = X(N)

60  NEXT N
70 NX = 0:NY = 0
90  HOME
100  REM  ** HEADINGS
110  PRINT "          LINEARITY TES
     T"
120  PRINT
125  PRINT "           CORRECT  REA
     D  ERROR     %"
130  PRINT " X - AXIS"
132  PRINT
135  PRINT "POINT 0 = ";X(0)
140  PRINT "POINT 1 = ";X(1)
150  PRINT "POINT 2 = ";X(2)
160  PRINT "POINT 3 = ";X(3)
170  PRINT "POINT 4 = ";X(4)
180  PRINT
190  PRINT " Y - AXIS"
195  PRINT
200  PRINT "POINT 5 = ";Y(0)
210  PRINT "POINT 6 = ";Y(1)
220  PRINT "POINT 7 = ";Y(2)
230  PRINT "POINT 8 = ";Y(3)
240  PRINT "POINT 9 = ";Y(4)
260  PRINT
270  PRINT "PRESENT POSITION"
280  PRINT
290  PRINT "     X =            Y
     ="
295  FLASH : VTAB 6: HTAB 18: PRINT
     " "
298  VTAB 14: HTAB 18: PRINT " ":
      NORMAL
300  REM  READ PADDLES
310  GOSUB 1000
312 XE =  INT ((X - X(NX)) * 100)
      / 100:PX =  INT (XE / .255)
      / 10
314 YE =  INT ((Y - Y(NY)) * 100)
      / 100:PY =  INT (YE / .255)
      / 10
```

need pots with values much greater than the standard values for your computer. The 1 meg-ohm pots listed work well for the Apple II, which normally uses 150K pots.

If you can't find good pots with the higher values, or if you find some especially good pots at a surplus store, you can use correction capacitors, as described in the first article in this series ("Rebuilding Game Paddles and Joysticks," *Creative Computing*, February 1983, pp. 140-150). Correction caps can easily be mounted in the pushbutton box, and you are much more likely to obtain straight lines if you use them.

The pushbuttons, which should be at least $^3/_8$" in diameter, are mounted in a small plastic box. Your fingers will tire quickly if the buttons are smaller than this. The correction caps, pull-down resistors (R1 and R2), and the filter cap (C1) are mounted on a small piece of printed circuit board that is placed in this box.

Wiring

For the electronics work on this project you will need a small pencil soldering iron of 25 to 40 watts and fine resin-core solder. The necessary hand tools are long-nose pliers, diagonal cutters, and wire strippers.

The cable from the pots to the pushbutton box must be very flexible and have at least three conductors.

```
320  REM  ** NOTE TEST POINTS
330  IF PT$ = "X" THEN  VTAB (6 +
     NX): HTAB 18: PRINT X;: HTAB
     25: PRINT XE;: HTAB 33: PRINT
     PX:NX = NX + 1
340  IF PT$ = "Y" THEN  VTAB (14 +
     NY): HTAB 18: PRINT Y;: HTAB
     25: PRINT YE;: HTAB 33: PRINT
     PY:NY = NY + 1
342  IF NX > 5 THEN NX = 5
344  IF NY > 5 THEN NX = 5
355  FLASH : VTAB (6 + NX): HTAB
     18: PRINT " ": NORMAL
365  FLASH : VTAB (14 + NY): HTAB
     18: PRINT " ": NORMAL
370  FOR N = 1 TO 500: NEXT N
380  IF NY = 5 AND NX = 5 THEN  GOTO
     400
390  GOTO 300
400  REM  ** TEST AGAIN ?
410  VTAB 20
420  INPUT "NEW TEST ? ( Y OR N )
      ";YN$
430  IF YN$ = "Y" THEN  GOTO 70
999  END
1000  REM  ** READ PADDLES SUBROU
     TINE
1010 X =  PDL (0)
1020  VTAB 22: HTAB 10: PRINT "
      ";
1025  HTAB 10: PRINT X
1027 P0B =  PEEK ( - 16287)
1028  IF P0B > 127 AND NX < 5 THEN
     PT$ = "X": RETURN
1030 Y =  PDL (1)
1040  VTAB 22: HTAB 25: PRINT "
      ";
1045  HTAB 25: PRINT Y
1070 P1B =  PEEK ( - 16286)
1080  IF P1B > 127 AND NY < 5 THEN
     PT$ = "Y": RETURN
1090  GOTO 1010
9999  END
```

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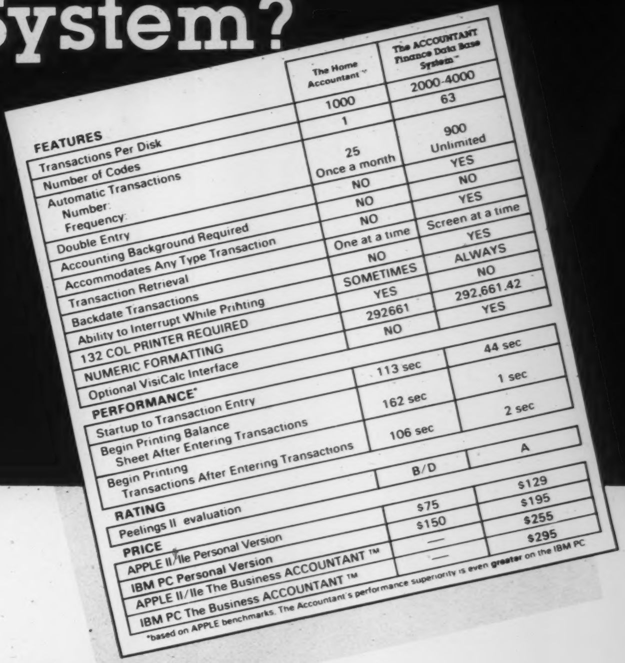

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CIRCLE 159 ON READER SERVICE CARD

Using four-conductor telephone cable with the +5 wire doubled up worked well for the prototype. The cable should be about 30" in length—long enough to loop to the top of the upright and then run to the pushbutton box. Figure 4 shows the pot terminals to which you will solder the wires.

The run from the pushbutton box to the plug requires six conductors. Two lengths of telephone cable will work nicely. Ribbon cable can also be used for this run if that is what you have on hand. If you have extra wires, double up the +5 supply and ground. The length of this cable will depend on how far away from the computer you want to place the sketch pad for general use.

The plug is a standard 16-pin DIP header. You can mount resistors R1 and R2 on it if you like. Be very careful to identify pin 1 by its marked corner. The cable usually enters the header from the pin 8 end.

The best way to check your wiring is to make two photocopies of Figure 5. On the first copy, color in each wire, component, and solder joint as you progress. Color in the second copy as a final check when you go over your work. This is standard practice in electronics.

Testing and Alignment

If you have a multimeter, check the resistance from pin 1 to ground pin 8. It should be at least 50 ohms (normally, it will be much higher) even when you press the buttons and turn the pots. Shut down your computer, plug in the sketch pad, and turn the computer on again. If your computer does not start up in the normal way, turn it off at once and recheck your work. If you have the paddle checkout program from the February article, run it. If not, you can use the linearity test program (Listing 1) to provide readings while you adjust the pots.

To adjust the pots, tape a blank piece of paper on the board and mark the spot in the center where the pencil is exactly straight up and down. With a program that shows the pot readings running, and with the clamping bolts loose, turn the pot shafts within the clamps until both readings are 128 when the pencil is on the mark.

Now tighten all three clamping bolts. Move the pencil around the paper and make marks at the 0 and 255 points in each direction. The reading in the top lefthand corner should be 0,0 just as the top lefthand corner of the hi-res graphics screen is 0,0. If one or both axes are backwards, you can reverse them by moving the +5 wire to the other outside pot terminal and resetting the 128,128 point.

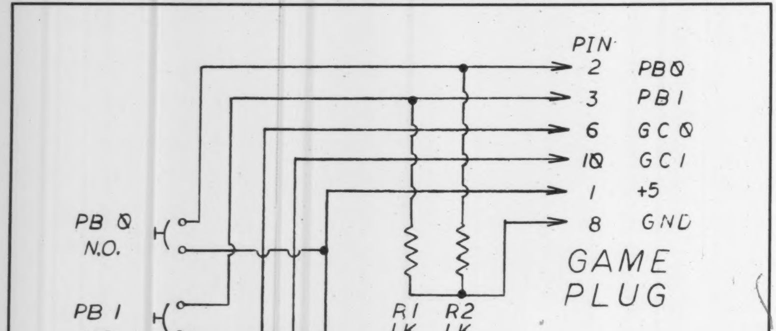

Figure 5. Sketch Pad Schematic.

Listing 2.

```
10  REM  ************************
11  REM  *
12  REM  *   DRAWING PROGRAM
14  REM  *        FOR
16  REM  *    THE HOME-BUILT
18  REM  *     SKETCH PAD
20  REM  *
22  REM  * TOM RILEY COPYRIGHT 83

24  REM  *
26  REM  **************************

30  REM
50  TEXT : HOME
70 C1 = 191:C2 = 255:C3 = 279
80 C = 3: HCOLOR= C
90 YN$ = "":D$ =  CHR$ (4)
100  REM  *** MAIN MENU
110  GOSUB 9000: REM  INTRODUCTIO
     N
120  GOSUB 8000: REM   MAIN MENU
125 YN$ = ""
130  IF A = 1 THEN  VTAB 22: INPUT
     " ARE YOU SURE ? (Y/N) ";YN$

135  IF YN$ = "Y" THEN  HGR : TEXT

140  IF A = 2 THEN  GOSUB 2000
150  IF A = 3 THEN  GOSUB 3000
160  IF A = 4 THEN  GOSUB 4000
170  IF A = 5 THEN  GOSUB 5000
180  IF A = 6 THEN  GOSUB 6000
190  IF A = 7 THEN  HOME : END
200  GOTO 120
2000  REM  ** GET A DRAWING FROM
     DISK
2010  HOME :D$ =  CHR$ (4)
2020  HTAB 7: PRINT "GETTING A DR
     AWING FROM DISK"
2030  VTAB 7: PRINT "    GETTING
     A DRAWING WILL DESTROY"
2040  INPUT "THE DRAWING NOW IN M
     EMORY.  OK ? (Y/N) ";YN$
2060  IF  LEFT$ (YN$,1) = "N" THEN
      RETURN
2070  PRINT
2080  INPUT "    CATALOG ? (Y/N)
     ";YN$
2090  IF  LEFT$ (YN$,1) = "Y" THEN
      PRINT D$;"CATALOG"
2100  PRINT
2110  INPUT "DRAWING NAME ? ";DN$

2120  PRINT D$;"BLOAD ";DN$
2130  RETURN
2999  END
3000  REM  *** SAVE DRAWING ON DI
     SK
3010  HOME
3020  HTAB 7: PRINT "SAVE A DRAWI
     NG ON DISK"
3040  VTAB 4: INPUT "    CATALOG
     ? (Y/N) ";YN$
3050  IF YN$ = "Y" THEN  PRINT D$
     ;"CATALOG"
3060  PRINT
3070  INPUT "DRAWING NAME ? ";DN$

3080  PRINT
```

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CIRCLE 267 ON READER SERVICE CARD

```
3090  INPUT "    IS THERE A DRAWI
     NG OF THAT NAME ON  THIS DIS
     K ? (Y/N) ";YN$
3100  IF YN$ = "Y" THEN  PRINT D$
     ;"DELETE ";DN$
3110  PRINT D$;"BSAVE ";DN$;",A$2
     000,L$2000 "
3190  RETURN
3999  END
4000  REM  *** CONTINUOUS POINT D
     RAWING
4010  TEXT : HOME
4020  HTAB 5: PRINT "DRAWING BY C
     ONTINUOUS POINTS"
4030  VTAB 5: PRINT "   THE POINT
      THE STYLUS IS ON WILL"
4040  PRINT "BE DRAWN REPEATEDLY.
     "
4045  PRINT
4050  PRINT "    THE ZERO (0) BUT
     TON WILL SHOW THE "
4060  PRINT "'X' AND 'Y' CO0RDINA
     TES AND HCOLOR."
4075  PRINT
4080  PRINT "    THE NUMBERS 0 TO
      7 WILL SELECT"
4090  PRINT "HCOLOR."
4095  PRINT
4100  PRINT "   THE ORIGIN IS THE
      UPPER LEFT CORNER."
4110  PRINT "FROM LEFT TO RIGHT I
     S X = 0 TO 279."
4120  PRINT "FROM TOP TO BOTTOM I
     S Y = 0 TO 191."
4125  PRINT
4140  PRINT "   PRESS 'ESC' TO RE
     TURN TO MAIN MENU."
4150  VTAB 23: INPUT "  ( PRESS R
     ETURN )  ";YN$
4155  HOME
4200  REM   *** SETTING GRAPHICS

4210  POKE  - 16297,0: POKE  - 16
     300,0: POKE  - 16302,0: POKE
      - 16304,0
4300  REM  *** WATCHING PADDLE
4320 X =  INT ( PDL (0) * C3 / C2 )
4330 Y =  INT ( PDL (1) * C1 / C2
     )
4340  HPLOT X,Y
4350 B0 =  PEEK ( - 16287):K =  PEEK
     ( - 16384): POKE  - 16368,0
4360  IF B0 > 127 OR K > 127 THEN
     4390
4370  GOTO 4320
4390  HOME
4400  IF B0 > 127 THEN  POKE  - 1
     6301,0: VTAB 22: PRINT "  X
     = ";X;"  Y = ";Y;"  HCOLOR =
      ";C: FOR I = 0 TO 1000: NEXT
     I: POKE  - 16302,0: GOTO 432
     0
4410  IF K = 155 THEN  RETURN
4420  GOSUB 4500
4430  GOTO 4320
4500  REM  *** CHECK HCOLOR
4510  IF K = 177 THEN C = 1: HCOLOR=
     C
4520  IF K = 178 THEN C = 2: HCOLOR=
     C
4530  IF K = 179 THEN C = 3: HCOLOR=
     C
4540  IF K = 180 THEN C = 4: HCOLOR=
     C
4550  IF K = 181 THEN C = 5: HCOLOR=
     C
4560  IF K = 182 THEN C = 6: HCOLOR=
     C
4570  IF K = 183 THEN C = 7: HCOLOR=
     C
4580  IF K = 176 THEN C = 0: HCOLOR=
     C
4999  RETURN
5000  REM   *** CONTINUOUS LINE D
     RAWING
5010  TEXT : HOME
5015  PRINT
5020  HTAB 7: PRINT "DRAWING BY C
     ONTINUOUS POINTS"
5030  VTAB 5: PRINT "    THE POIN
     T THE STYLUS IS ON WILL"
5040  PRINT "BE USED AS THE END P
     OINT OF A LINE"
5050  PRINT "DRAWN FROM THE LAST
     LINE'S END POINT."
5060  PRINT
5070  PRINT "    THE ZERO (0) BUT
     TON WILL DISPLAY"
```

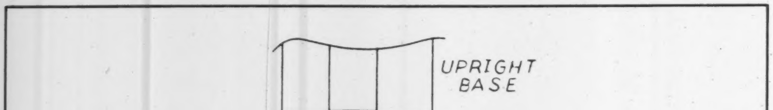

Figure 6. Linearity Test.

Try moving the upright up and down to change scale. Mark the 0 and 255 limits for different upright heights to learn the range of sizes available for drawings. You should be able to adjust from about 6″ × 8″ down to 3″ × 4″. If 0 and 255 fall off the baseboard, you will need the correction caps as discussed earlier.

Linearity Test

The program in Listing 1 provides a test of the linearity of your pots and the accuracy of the sketch pad as a whole. To make this test you will need paper, compass, and straight edge. Tape the paper to the board and run Listing 1.

As shown in Figure 6, draw a line front to back down the center of the paper. Mark the points on this line where Y, as shown on the screen, just becomes 0 and where it reaches 255. Using the compass, bisect this line (the required arcs are shown in Figure 6). Draw the bisecting line completely across the paper. Bisect each half of the first line with short cross marks. Mark the points on this line 5, 6, 7, 8, and 9, as shown in Figure 6.

Mark the 0 and 255 points on the X axis line and bisect the line between the points. The central point #2 may or may not fall exactly on the Y axis. Bisect each half of the Y line and mark points 0 to 4.

Now for the linearity test. Carefully place the pencil on point 0 and press the 0 button, then do the same for points 1, 2, 3, and 4 in turn. Move to points 5 through 9 and on each press pushbutton 1. The screen will now show the correct reading for each point, the value actually read, the error, and the error as a percentage of full scale. The lowest repeatable score could have as low as 0.5% as the worst error percentage. Sketch pads with error rates below 4% will generally produce good drawings. Run the test several times to see how good you are at hitting the same points. Pots with large error values will draw distorted pictures, but the distortions may lead to interesting effects.

After testing the unit as described, you may want to cover the exposed wires on the pots and the DIP header with several coats of fingernail polish or with silicone sealer. Gluing cotton felt to the bottom of the pushbutton box will keep it from scratching the desktop. Be sure to mark pushbuttons 0 and 1 clearly.

The Drawing Program

Now that the device (and perhaps its builder) have been thoroughly tested, we can begin to draw with the sketch pad. Listing 2 is a fairly detailed sketching program. It lets you draw pictures in three different modes, save your work on

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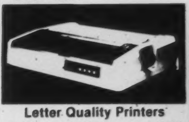

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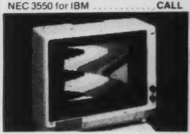

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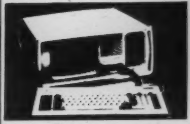

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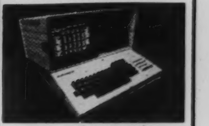

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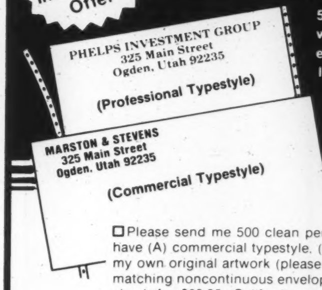

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CIRCLE 149 ON READER SERVICE CARD

```
5080  PRINT "'X' AND 'Y' COORDINA
     TES AND THE HCOLOR."
5090  PRINT
5100  PRINT "    PRESSING A NUMBE
     R 0 THROUGH 7 WILL"
5110  PRINT "CHANGE HCOLOR TO THA
     T NUMBER."
5120  PRINT
5130  PRINT "    PRESSING THE 'ES
     C' KEY WILL RETURN"
5140  PRINT "YOU TO THE MAIN MENU
     ."
5190  VTAB 23: INPUT "  ( PRESS R
     ETURN TO CONTINUE )  ";YN$
5195  HOME
5200  REM   *** SETTING GRAPHICS
5210  POKE  - 16297,0: POKE  - 16
     300,0: POKE  - 16302,0: POKE
      - 16304,0
5300  REM   *** WATCHING PADDLE

5310  REM  *** X POT 0 , Y POT 1

5320 X =  INT ( PDL (0) * C3 / C2
     )
5330 Y =  INT ( PDL (1) * C1 / C2
     )
5340 X1 = X:Y1 = Y
5350 X =  INT ( PDL (0) * C3 / C2
     )
5360 Y =  INT ( PDL (1) * C1 / C2
     )
5370  HPLOT X,Y TO X1,Y1
5380 X1 = X:Y1 = Y
5390 B0 =  PEEK ( - 16287):K =  PEEK
     ( - 16384): POKE  - 16368,0
5400  IF B0 > 127 OR K > 127 THEN
     5420
5410  GOTO 5350
5420  IF B0 > 127 THEN  POKE  - 1
     6301,0: VTAB 22: PRINT "  X
     = ";X;"  Y = ";Y;"  HCOLOR =
      ";C;"       ": FOR I = 0 TO
     1000: NEXT I: POKE  - 16302,
     0: GOTO 5350
5430  IF K = 155 THEN  RETURN
5440  GOSUB 4500
5510  GOTO 5350
5999  END
6000  REM  *** REFERENCE POINT LI
     NES
6010  TEXT : HOME
6030  HTAB 7: PRINT "DRAWING BY R
     EFERENCE POINTS"
6040  VTAB 3: PRINT "    THE STYL
     US AND PADDLE BUTTONS"
6050  PRINT "ARE USED TO FIND REF
     ERENCE POINTS AND"
6060  PRINT "THEN DRAW LINES BETW
     EEN THEM."
6070  PRINT
6080  PRINT "    THE ZERO (0) BUT
     TON DISPLAYS "
6090  PRINT "THE 'X' AND 'Y' COOR
     DINATES AND HCOLOR."
6100  PRINT
6110  PRINT "    THE ONE (1) BUTT
     ON WILL FIX THE"
6120  PRINT "STYLUS LOCATION AS A
      REFERENCE POINT."
6130  PRINT "WHEN A SECOND REFERE
     NCE POINT IS CHOSEN"
6140  PRINT "A LINE IS DRAWN BETW
     EEN THEM."
6150  PRINT
6160  PRINT "    PRESSING KEY 'C'
      CLEARS THE"
6170  PRINT "REFERENCE POINTS."
6180  PRINT
6190  PRINT "    PRESSING A NUMBE
     R BETWEEN 0 AND 7"
6200  PRINT "SELECTS HCOLOR."
6210  PRINT
6230  PRINT "    PRESSING 'ESC' R
     ETURNS YOU TO"
6240  PRINT "THE MAIN MENU."
6250  VTAB 23: INPUT "       ( PRE
     SS RETURN )   ";YN$
6260  HOME
6270  REM  *** SETTING GRAPHICS
6280  POKE  - 16297,0: POKE  - 16
     300,0: POKE  - 16302,0: POKE
      - 16304,0
6290  HOME
6300  REM  ** WATCHING PADDLES
6305 DD = 0
6310 X =  INT ( PDL (0) * C3 / C2
     )
6315 Y =  INT ( PDL (1) * C1 / C2
     )
6320 B0 =  PEEK ( - 16287):B1 =  PEEK
     ( - 16286):K =  PEEK ( - 163
     84): POKE  - 16368,0
6330  IF B0 > 127 OR B1 > 127 OR
     K > 127 THEN 6350
6340  GOTO 6310
6350  IF B0 > 127 THEN  POKE  - 1
     6301,0: VTAB 22: PRINT "  X
     = ";X;"  Y = ";Y;"  HCOLOR =
      ";C;"     ": FOR I = 0 TO 1
     000: NEXT I: POKE  - 16302,0
     : GOTO 6310
6360  IF B1 > 127 AND DD = 0 THEN
     X1 = X:Y1 = Y:DD = 1: HPLOT
     X,Y: VTAB 23: PRINT "  REF P
     OINT 1 SELECTED": FOR I = 0 TO
     500: NEXT I: GOTO 6380
6370  IF B1 > 127 AND DD = 1 THEN
      HPLOT X1,Y1 TO X,Y:DD = 0: FOR
     I = 0 TO 500: NEXT I: HOME
6380  IF K = 155 THEN  RETURN
6390  GOSUB 4500
6400  IF K = 195 THEN DD = 0: HOME
     : HCOLOR= 0: HPLOT X1,Y1: HCOLOR=
     C
6410  GOTO 6310
6999  END
8000  REM   *** MAIN MENU
8010  TEXT : HOME
8020  HTAB 14: PRINT "MAIN MENU"
8030  VTAB 5
8040  HTAB 8: PRINT "(1) CLEAR HI
     -RES SCREEN"
8045  PRINT
8050  HTAB 8: PRINT "(2) GET DRAW
     ING FROM DISK"
8055  PRINT
8060  HTAB 8: PRINT "(3) PUT DRAW
     ING ON DISK"
8065  PRINT
8070  HTAB 8: PRINT "(4) DRAW CON
     TINUOUS POINTS"
8075  PRINT
8080  HTAB 8: PRINT "(5) DRAW CON
     TINUOUS LINES"
8085  PRINT
8090  HTAB 8: PRINT "(6) DRAW REF
     ERENCE POINT LINES"
8095  PRINT
8100  HTAB 8: PRINT "(7) QUIT "
8110  VTAB 22: INPUT "  CHOOSE A
     NUMBER :  ";A
8120  IF A < 0 OR A > 7 THEN  GOTO
     8110
8130  RETURN
8999  END
9000  REM  ***    INTRODUCTION
9010  VTAB 1: HTAB 10: PRINT "SKE
     TCHING PROGRAM"
9020  HTAB 16: PRINT "FOR"
9030  HTAB 8: PRINT "HOME-BUILT S
     KETCH PAD"
9040  VTAB 5: PRINT "    THIS PRO
     GRAM WAS PREPARED FOR USE"
9050  PRINT "WITH THE HOME-BUILT
     SKETCH PAD."
9060  PRINT "IT MAY BE USED WITH
     EITHER THE SKETCH"
9070  PRINT "PAD OR ANY DOUBLE PO
     T PADDLE."
9080  PRINT
9090  PRINT "    THE MAIN MENU WI
     LL LET YOU CHOOSE"
9100  PRINT "TO DRAW IN SEVERAL D
     IFFERENT WAYS OR"
9110  PRINT "MOVE DRAWINGS ON OR
     OFF THE DISK."
9120  PRINT
9130  PRINT "    WITH A LITTLE PR
     ACTICE YOU WILL"
9140  PRINT "SOON CHOOSE WHICH WA
     Y YOU LIKE BEST."
9190  VTAB 23: INPUT " ( PRESS TH
     E RETURN KEY TO CONTINUE ) "
     ;YN$
9195  RETURN
9999  END
```

disk, and retrieve it. The program is menu-driven and includes three pages of instructions.

First tape a clean piece of paper onto the board. To run the program, select item 1 on the menu to clear the hi-res screen. Next enter item 4, Drawing Continuous Points, and read the instructions. Press RETURN. As you move the pencil, dots will appear on the screen. The 0 pushbutton will show the values X, Y, and HCOLOR. Pressing numbers 1 through 7 on the keyboard will change HCOLOR to the number pressed. The ESCAPE key will bring you back to the main menu.

Again, press 1 to clear the screen; now select item 5, Drawing by Continuous Lines. The rules are similar to those for selection 4, but we think the resulting drawings look better. You might trace a plastic circle template to see how distorted the circles are on the hi-res screen. Tracing the same shape several times will give you some idea of how accurately you can copy drawings. Press ESCAPE to return to the main menu.

The third drawing mode is 6 on the menu, Drawing by Reference Point Lines. Both pushbuttons are used here. Pushbutton 0 does just what it did before. Pushbutton 1 has a new function: it fixes the stylus location as a reference point, which will be shown as a small blinking cursor on the screen. To draw in this mode, think of your picture as a series of straight lines. Move the stylus to one end of a line and press button 1. Find the other end of the line and press 1 again. A line will appear on the screen between the reference points. This drawing mode is least affected by the nonlinearity of the pots.

You can use all three modes in one picture: draw straight lines with the reference point mode, draw curves with the continuous line mode, and fill in areas with the continuous points mode. To erase, simply change HCOLOR to 0 or 4 (black) and retrace the line. You can shift between modes without erasing the screen.

Main menu selections 2 and 3 place and retrieve the entire hi-res screen on the disk (this requires 34 disk sectors). Practice saving and retrieving a simple practice sketch before spending too much time on a drawing. You don't want to risk losing a masterpiece by making a simple mistake.

The Digitizing Program

Listing 3, the digitizing program, assumes that you have a stack of up to 41 graphs or charts, each with up to 15 data points, and that you need to transfer this information into the computer. You must first name the disk file. If you want to add to an existing file, answer that the file is not new—the program will get the file off the disk.

Adjust the height of the sketch pad upright so that the stylus will just cover the entire area where points are found on any of the graphs. If all your graphs are the same size, make a reference corner by taping strips of cardboard to the sketch pad base. This will make it easy to place each graph in the same location.

Write down the values of X=0, X=255, Y=0, and Y=255 on the axes of the graphs. These readings will be needed in the next step. Press pushbutton 0 to continue.

Enter the units of the X axis (centimeters, days, whatever), then the graph axis value for X=0 and the graph axis value when X=255. Do the same for the Y axis. Since the 0,0 point is in the upper lefthand corner, the value for Y=0 is usually larger than the value for Y=255.

Now you are ready to transcribe data. Place sheet 0 on the baseboard, move the stylus to the first point, and press pushbutton 0. The screen will show the X reading, the Y reading, the X axis value in the X units of the graph, and the Y axis value in the Y units. Continue moving the stylus and pressing pushbutton 0 to enter up to 15 data points.

Pressing pushbutton 1 at any time will bring up a question asking if a new sheet is desired. A yes answer brings up a new sheet, a no answer sends you to the disk storage routine.

This digitizing program is an example to get you started. You will probably want to add correction features and restructure the data files to suit your data reduction programs. The number of sheets and points is limited by the size of your computer memory.

Summing Up

The sketch pad is an inexpensive, easy-to-build device that can be used for computer art work and data entry. Its major limitation is the imprecise linearity of inexpensive pots. (Commercial units, however, also have difficulty achieving good linearity.) The programs included here let you check the quality of the sketch pad and help you get started with drawing and data entry.

In our next article we will look at the construction of joysticks for the Atari. Some of these will be conventional in shape, while others will be strikingly new and have a very fast response. □

Listing 3.

```
10  REM  ***********************
12  REM  *
14  REM  * DIGITIZER
16  REM  *
18  REM  * TOM RILEY COPYRIGHT 83

20  REM  *
22  REM  ***********************
24  REM
30  DIM PT%(40,2,15)
35  REM    * LIMITS 41 PAGES WITH
      16 DATA POINTS PER PAGE
50 D$ =  CHR$ (4)
60 PTN = 1:SN = 0
100  REM  *** NAME OF FILE
110  HOME
120  PRINT "   DIGITIZING WITH SK
     ETCH PAD"
130  PRINT : PRINT
140  INPUT "NAME OF FILE ? ";F$
150  PRINT
160  INPUT "IS THIS A NEW FILE ?
     (Y OR N) ";YN$
170  PRINT
175  IF YN$ = "Y" THEN  GOTO 300
180  INPUT "IS DISK WITH THIS FIL
     E IN THE DRIVE ? ";Q$
185  PRINT
190  IF Q$ = "N" THEN  PRINT "PUT
      THE CORRECT DISK INTO THE D
     RIVE.": GOTO 170
200  REM  ** READING FILE FROM DI
     SK
210  PRINT D$;"OPEN ";F$
220  PRINT D$;"READ ";F$
230  INPUT SN
232  INPUT UX$: INPUT UY$
234  INPUT X0V,XMV,Y0V,YMV
235  FOR R = 0 TO SN
240  FOR S = 0 TO 1
245  FOR T = 0 TO 15
250  INPUT PT%(R,S,T)
260  NEXT : NEXT : NEXT
270  INPUT EOF$
280  PRINT D$;"CLOSE ";F$
285  IF EOF$ <  > "EOF" THEN  PRINT
     "FILE READING ERROR ": END
300  REM  *** ADJUST SKETCH PAD
310  HOME
320  PRINT "   ADJUST SKETCH PAD"

330  PRINT : PRINT
340  PRINT "      USE THE X AND Y
     READINGS BELOW"
350  PRINT "TO ADJUST THE LOCATIO
     N OF THE SHEET"
360  PRINT "AND THE HEIGHT OF THE
      UPRIGHT."
370  PRINT
380  PRINT "      PRESS PB0 TO CON
     TINUE."
390  VTAB 16: PRINT "       X =
        Y ="
400  REM  * READ PADDLES
410 X =  PDL (0)
420  VTAB 16: HTAB 10: PRINT "
     ";
430  HTAB 10: PRINT X
440 P0B =  PEEK ( - 16287)
450  IF P0B > 127 THEN  GOTO 500
460 Y =  PDL (1)
470  VTAB 16: HTAB 20: PRINT "
     ";
480  HTAB 20: PRINT Y
490  GOTO 410
500  REM  ** SCALE INFORMATION
510  HOME
520  PRINT "SCALING INFORMATION "

530  PRINT
540  INPUT "UNITS OF X AXIS ? ";U
     X$
550  PRINT
560  INPUT "VALUE FOR X=0 ? ";X0V

570  INPUT "VALUE FOR X MAX. ? ";
     XMV
580  IF X0V = XMV THEN  GOTO 550
590  PRINT
600  INPUT "UNITS FOR Y AXIS ? ";
     UY$
610  PRINT
620  INPUT "VALUE FOR Y=0 ? ";Y0V

630  INPUT "VALUE FOR Y MAX. ? ";
     YMV
640  IF Y0V = YMV THEN  GOTO 610
650  PRINT
660 AX = (XMV - X0V) / 255
670 AX =  INT (AX * 1000) / 1000
680 AY = (YMV - Y0V) / 255
690 AY =  INT (AY * 1000) / 1000
800  REM  *** TAKE DATA
810  HOME
820  PRINT "PRESS PB0 TO TAKE DAT
     A"
830  PRINT "PRESS PB1 TO START NE
     W SHEET"
870  PRINT
875  PRINT "SHEET NUMBER =  ";SN
877  PRINT
880  PRINT "             X    Y";
885  HTAB 20: PRINT "X-";UX$;: HTAB
     30: PRINT "Y-";UY$
890  PRINT
900  FOR N = 1 TO 15
910  PRINT " PT ";N;" =  0"
920  NEXT N
930  VTAB 24: PRINT "      X =
      Y =    ";
1000  REM   * READ PADDLES
1010 X =  PDL (0)
1020 XV = AX * X + X0V
1025 XV =  INT (XV * 1000) / 1000

1030 P0B =  PEEK ( - 16287)
1040 P1B =  PEEK ( - 16286)
1045  VTAB 24: HTAB 10: PRINT "
      ";
1047  HTAB 10: PRINT X;
1050 Y =  PDL (1)
1055 YV = AY * Y + Y0V
1056 YV =  INT (YV * 1000) / 1000

1057  HTAB 20: PRINT "   ";
1058  HTAB 20: PRINT Y;
1060  IF P0B > 127 THEN PT%(SN,0,
     PTN) = X:PT%(SN,1,PTN) = Y: VTAB
     (7 + PTN): HTAB 10: PRINT X;
     : HTAB 14: PRINT Y;: HTAB 20
     : PRINT XV;: HTAB 30: PRINT
     YV:PTN = PTN + 1
1065  FOR N = 1 TO 200: NEXT
1070  IF P1B > 127 OR PTN > 15 THEN
      GOTO 1200
1100  GOTO 1000
1200  REM  ** NEW SHEET
1203  IF PTN >  = 15 THEN  GOTO 1
     210
1205  FOR N = PTN TO 15
1207 PT%(SN,0,N) = 0:PT%(SN,1,N) =
     0
1208  NEXT
1210 SN = SN + 1
1220 PTN = 1
1240  PRINT " ": VTAB 23
1250  INPUT "ANOTHER SHEET ? (Y O
     R N) ";YN$
1260  IF YN$ = "Y" GOTO 800
1300  REM  ** SAVE FILE TO DISK
1310  HOME
1320  PRINT "    SAVE FILE TO DIS
     K"
1330  PRINT
1340  INPUT "IS STORAGE DISK IN T
     HE DRIVE ? ";YN$
1350  PRINT
1360  IF YN$ = "N" THEN  PRINT "P
     LACE THE STORAGE DISK IN THE
      DRIVE.": GOTO 1330
1370  PRINT
1380  INPUT "IS THIS A NEW FILE O
     N THIS DISK ? ";YN$
1390  PRINT
1400  IF YN$ = "N" THEN  PRINT D$
     ;"DELETE ";F$
1410  PRINT
1420  PRINT D$;"OPEN ";F$
1430  PRINT D$;"WRITE ";F$
1440  PRINT SN
1444  PRINT UX$: PRINT UY$
1446  PRINT X0V: PRINT XMV: PRINT
     Y0V: PRINT YMV
1450  FOR R = 0 TO SN
1460  FOR S = 0 TO 1
1470  FOR T = 0 TO 15
1480  PRINT PT%(R,S,T)
1490  NEXT : NEXT : NEXT
1500  PRINT "EOF"
1510  PRINT D$;"CLOSE ";F$
1520  GOTO 60
9999  END
```

The Metaphysical Exam

Peter Payack

I was feeling a bit gloomy for a few days
so I made an appointment with my doctor for a check-up.
Seeing me stumble into his office
with a blank expression, lowered jaw, and drooping shoulders
he escorted me into his examination room and began with
the most unusual type of medical procedure:
The Metaphysical Exam!

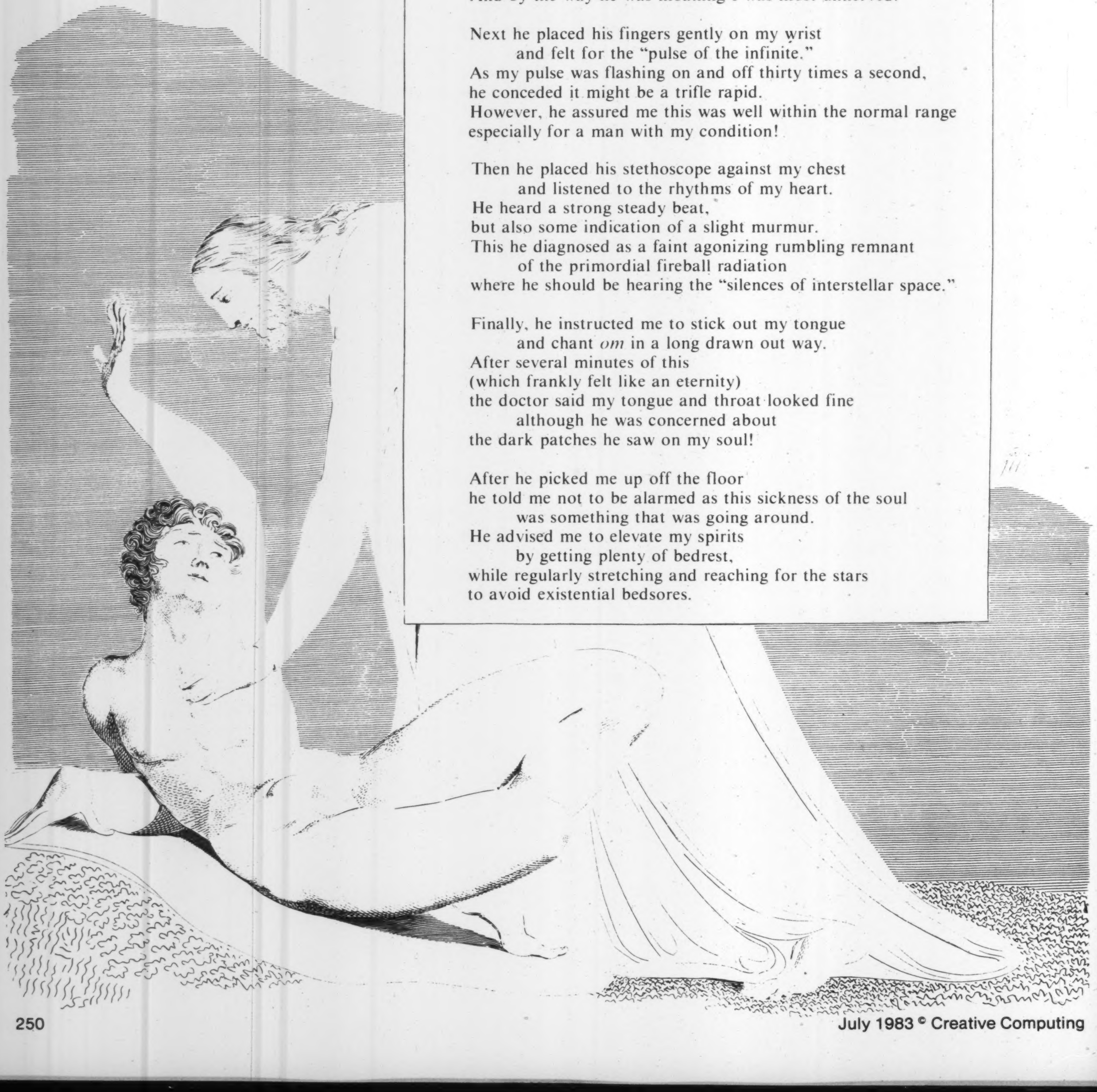
The first thing he did was to lower the lights
and look deep into the pupils of my no longer twinkling eyes
with the aid of a small telescope.
He stared with such astonishing intensity that he claimed
to see directly into the innermost essence of my being.
And by the way he was moaning I was most unnerved.

Next he placed his fingers gently on my wrist
and felt for the "pulse of the infinite."
As my pulse was flashing on and off thirty times a second,
he conceded it might be a trifle rapid.
However, he assured me this was well within the normal range
especially for a man with my condition!

Then he placed his stethoscope against my chest
and listened to the rhythms of my heart.
He heard a strong steady beat,
but also some indication of a slight murmur.
This he diagnosed as a faint agonizing rumbling remnant
of the primordial fireball radiation
where he should be hearing the "silences of interstellar space."

Finally, he instructed me to stick out my tongue
and chant *om* in a long drawn out way.
After several minutes of this
(which frankly felt like an eternity)
the doctor said my tongue and throat looked fine
although he was concerned about
the dark patches he saw on my soul!

After he picked me up off the floor
he told me not to be alarmed as this sickness of the soul
was something that was going around.
He advised me to elevate my spirits
by getting plenty of bedrest,
while regularly stretching and reaching for the stars
to avoid existential bedsores.



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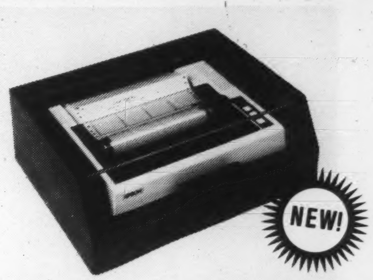

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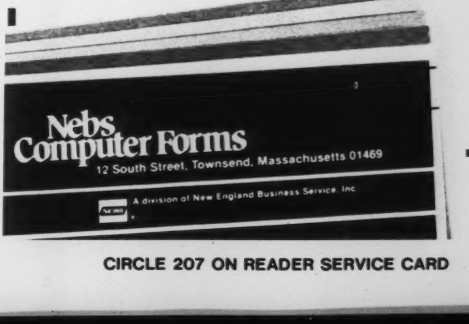
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John J. Anderson

I had the opportunity recently to attend the International Apple Core user's group conference in Santa Clara, CA. Apple footed the bill for attendance by representatives of over 90 user's groups in the U.S. and Canada. The IAC has a membership of over 80,000, all told, in some 4000 independent groups. I met representatives from as far away as West Germany and Australia.

IIe or not IIe

The reason for the three day party at the Marriott Hotel was to introduce the fold to the IIe, and the IIe into the fold. Apple personnel who were part of the development of the IIe were on hand to discuss the machine, highlight the differences between it and the older Apple, and provide insight into its improvements.

It is to Apple's credit that they reached out to the user's group level in the introduction of the IIe. "We recognize the contribution that user's groups have made to the success of our products, particularly the Apple II," said Paul Dali, general manager of the Personal Computer Systems Division, who was also the lead-off speaker. "Apple's growth can be attributed, in part, to the increase in the number of Apple user group members over the last few years. We want to continue this relationship by personally presenting the Apple IIe to our users."

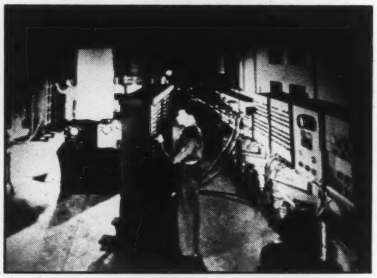
An Apple van unloads goodies at the Santa Clara Marriott.

Would that other microcomputer manufacturers were likewise to acknowledge the importance of the user's group as an indispensable support system. Not to mention spending over $100,000 merely to introduce its new machine to members of those groups. Apple user's groups may have their complaints about Apple (and believe me, they do), but undeniably, Apple is providing tangible support.

Phil Roybal, communications manager now headed to an appointment as head of Apple Europe, gave a zealous overview of the computer age. Roybal is an inspiring and riveting speaker, nearly religious in his fervor. I had to fight the urge to shout "amen." Roybal reminded the group that the first Apple IIs, those groundbreaking "bicycles of the mind," as he called them, were delivered on May 10, 1977. It *is* rather dizzying to think how quickly the personal computer revolution has come upon us.

After 13 revisions to the Apple II, the IIe has arrived on the scene. It is priced below a comparably configured Apple II, and includes 64K, upper- and lowercase, and a selectric-style (as opposed to Teletype) keyboard standard. The system will accept a low-cost 80-column card, and is being introduced around the world with a variety of local-language keyboards. Danny Goodman made a first examination of the IIe in the March issue of *Creative Computing*.

It is Walt Broedner, IIe logic designer, who can be largely credited with lowering the chip count from 110 ICs in the original Apple, to 31 in the IIe. Two new LSI circuits replace approximately 80 separate circuits used in the earlier models. This feat lowers costs and increases reliability substantially, and is the single most impressive feature of the Apple IIe. The measured mean time between failures on the IIe is over 20,000 hours.



Phil Roybal cited Eniac as the first personal computer: only Mauchly and Eckert knew how to use it.

Broedner told the story of the LSI chips to the assembled hackers as follows:

"The Apple IIe project was started back in 1978, when I was working at Synertec. Woz, Jobs, and some other people at Apple were looking at possible competition from TI and Atari. They realized the need for a custom LSI design that would make the Apple II cheaper. They approached Synertec, and that's how I met Woz and Jobs.

"I soon after became a resident Synertec employee at Apple, and found out really quickly that it was nice working there. Woz was busy designing the disk controller at the time, and even though

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CIRCLE 137 ON READER SERVICE CARD

my desk was right outside his office, I hardly ever got a chance to see him. We would discuss the architecture of the new Apple machine a few minutes in the morning and a maybe a few minutes in the afternoon, if I could catch him.

"We were finally able to define a system, and I got approval from Woz to go ahead with it. So I went back to Synertec and started to design a breadboard. It was a humongous thing—it had over 400 ICs, if you can believe it—and this was for only one of the two chips that would be part of the system. The project was code-named Annie, for Apple Annie, I guess.

SANTA CLARA
Marriott Hotel

George Johnson reminded us that the Apple II is a hard act to follow.

"Annie was going to be totally NTSC compatible, by the way. We got the breadboard system running, and it was impressive to see. It did flicker, though, as all interlace systems do.

"We were more than halfway through with the drawings for the LSI chips by this time, when the project got shelved. TI and Atari hadn't materialized, and Woz had been very successful with the disk controller. At that point Apple decided that it would be better to try for a jump in the state of the art, than to introduce another Apple II. And that is how the Apple III was born.

"I almost had a heart attack then. After sticking with Synertec for another six months, I joined Apple, and went to work on the III. Meanwhile, some executives at Apple still felt that a cost reduction on the II was a good thing, and started doing an off-the-shelf type reduction. Woz had a lot to do with that—the project was called Alice, after Woz's wife, I believe. An engineer named Earl Smith took over the project, which then was named Diana, after his mother. This was essentially an Apple II, done with off-the-shelf components. It was starting by then to look a bit like a IIe. It had upper- and lowercase, and the language card was included.

"With my IC background, I knew there were better ways to reduce the chip count than just with off-the-shelf components. The problem with customizing, as everybody in the industry knows, is that turnaround is very long. I pushed a bit to see if I could be allowed to conduct a bit of research on customizing the Apple II, and got the OK to do a study on gate arrays. But gate arrays were overkill. The Apple doesn't have that much logic. The way to go was with customs.

"The idea of customs finally went over at Apple, for a number of reasons. First of all, Apple could own the chips, and retain all rights to them. Since Apple would own the masks, it could have the chips produced by more than one house. And since the IIe was a 6502-based machine, the custom chips could remain compatible as peripherals of the 6502.

"To that end we designed a new breadboard. We generated all the logic that we knew was going to be resident on the IOU and MMU custom chips, and simulated it with TTL components. We were able, therefore, to build an operational machine, plus or minus any special features, all the way through development of the IIe. That way it was always more than just a blueprint. It was a working model.

"The turnaround on the customs was only about 24 weeks. Adam came first, that was the MMU, and to everybody's surprise, it worked. We knew that Eve, the IOU, couldn't work, because the MMU had. Two weeks later, we were surprised again, because the IOU, which was much more complicated, worked too.

"At the time, we were working for 100% compatibility with the Apple II. Since the Apple IIe is really a different machine, that was a tall order. And not soon after, I discovered a bug in the MMU. This led to the revision B Apple IIe. In a way I was lucky to find this bug, because in fixing it I discovered how to generate double density hi-res.

"I decided to integrate into the IIe all of the functionality that was needed to support inexpensive 80-column capability. That is how the auxiliary slot was born. In fact, on an earlier model there were two slots: a 50-pin test slot, and a 30-pin 80-column slot. It became obvious that most of the signals were duplicated on the two slots, so we merged them into one 60-pin auxiliary slot. The slot can give you 80 columns, or another 64K plus 80 columns, and it also facilitates testing of IIes on the assembly line. Testing computers is a complicated affair. The more signals you can offer a tester, the easier it is to diagnose a board. That was a very important function that we gave to the auxiliary slot."

Broedner has begun his own company, Video-7, that is producing the first third-party auxiliary slot board for the Apple IIe. Beside being an 80-column card, the board provides color RGB output. "In the future all computer video output will be RGB," says Broedner. "And the Apple IIe will be among those to produce it." The introduction of the Video-7 80-Column Card caused a lot of interest at the conference. There on a IIe, alongside conventional NTSC color video, was clean, crisp and colorful RGB video. For more information, contact Video-7, 14550 Pike Rd., Saratoga, CA 95070.

Rich Auricchio, IIe firmware developer, had this to say about his own involvement in the IIe project:

"I've been with Apple since 1979, and I was the unfortunate soul selected to do the firmware for the Apple IIe. I got out of college in 1973 with a B.A. in computer science, and when I got into the software business, people didn't know I was for real. I was working with people who were science teachers, psychology majors, and ex-disk jockeys—it was rather strange. They asked things like 'You went to college to learn this stuff?' "

"I worked on mainframes for several years, and had no idea at the time that I was going to end up in the Disneyland of computing. I met Woz and Jobs in 1976, at the PC Festival in New Jersey, where I used to live. They were hawking the

Rick Auricchio spilled the secrets of IIe firmware.

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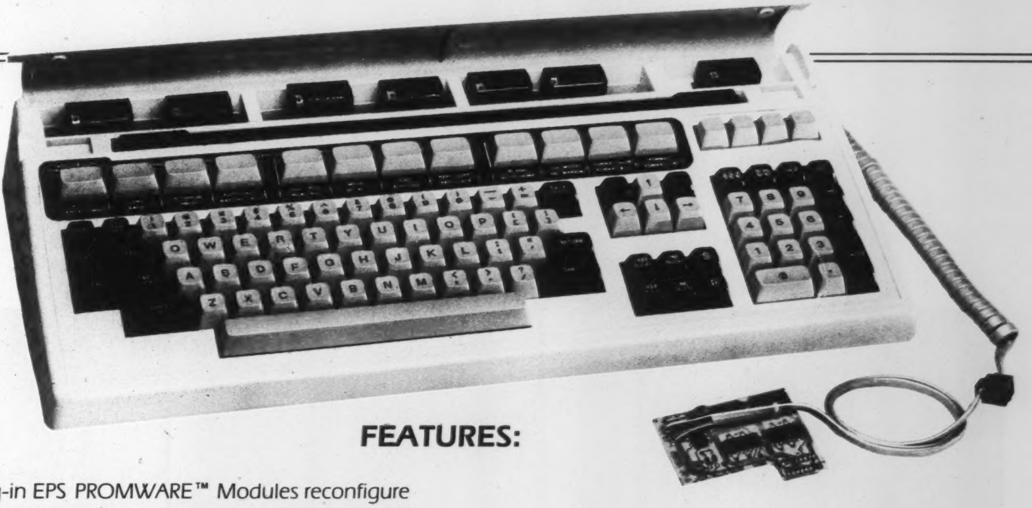

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CIRCLE 163 ON READER SERVICE CARD

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CIRCLE 275 ON READER SERVICE CARD

Apple Cart, continued...

Apple I at the time, for $666. In 1977 I read Woz's article on the Apple II, the one that is now just about required reading for all Apple hackers. Two months later I bought an Apple II with the serial number 183. I went into the only Computerland in the country at the time, which was in Morristown, NJ, and saw the machine doing graphics. There was no documentation, but no mirrors or wires running under the table, so I put down my $1700 for a 16K machine.

"It was a Rev.0 board: there was only four-color hi-res, without red and blue; there were no cooling vents in the thing; it didn't reset when you powered on, as it had an old monitor ROM; and I stuck with cassette for almost a year. I didn't even get a reference manual with it. They gave you about 20 pages of Xeroxed documentation.

"I wanted a listing of the monitor ROM, so I wrote to Apple. I got a handwritten thing back from (Mike) Markkula, with the listing. I began hacking in earnest. I disassembled Integer Basic, while waiting for a disk drive. I wrote to Apple again and asked them if they had a disassembly of Integer. They laughed and said no, Woz had assembled it by hand and typed it in directly in hex. Woz was like that—he would go to a party and type in 5K of Basic just to show somebody a little game program. That was Woz. The guy was a real believer.

Rick gave some rare looks at early prototypes. Note the cardboard monitor (never released).

"I ended up mailing them (Apple) a listing of Integer Basic as I saw it, with a lot of comments as to what I thought it did. This led to a correspondence, and finally a job...

"Well the Apple IIe came along as Walt said. And the important thing as we saw it was that its first name had to be II. That's one of the reasons why we couldn't go crazy with some of the weird Apple III stuff. So we got our hotshots going on the project. Around August 1981, the first IIe wire-wraps landed on my desk. 'Okay, write firmware,' they said. Each wire-wrap had its own flavor keyboard—we were experimenting with them. None was interchangeable with IIs, IIIs, or each other. If you screwed up one of those babies, you had to build another one from scratch.

The other new member of the family, Lisa. Really sexy, and not overpriced, at least for the time being.

"So that's when it started, around August of 1981. As for when it will be finished, well, soon, I hope. The minute you go to ROM, of course, things get changed. We know that well. And I nearly went off the deep end in the process.

"One simple thing that helped was naming the machines. A friend of mine at an adjacent desk had a couple of these little cut-outs from a box of Crackerjacks or something. I stuck two of them on our prototypes, and they became Flash and Superman. And suddenly, we were able to name them to each other. We could say things like 'the Flash has a problem,' and 'Superman doesn't,' and thereby tell one emulator from another. It was a breakthrough.

"Back when we had the emulators, I was able to hit 94,000 on *Galaxian*. That was one of the things that kept my mind lubricated while I was working on software. I could go into the lab and get on one of the wire-wraps and run *Galaxian*. I had to make sure that the game I/O worked, and the color graphics were there, you see. So I tested these things periodically, and came out with welts on my fingers from this phase of the work.

"In December of '81, the real IOU and MMU arrived. We couldn't believe it—actually we were surprised that they worked. We paid tribute to the great god at Synertec."

Soon after Rick spoke, a blackout, probably caused by the atrocious weather California endured throughout my entire visit, marred the festivities, and fortunately was the only mishap at the conference. It lasted about two and a half hours, and obliterated IIe product manager Sue Berman's time at the rostrum. She made a brave go of it, however.

That evening the entire group was ferried to Fisherman's Wharf for dinner, drinks, and to meet Lisa, Apple's new high-end entry. Look for a review of this remarkable machine in the pages of *Creative* soon.

Lisa was designed to come apart without the need for a screwdriver. Changing boards is a literal snap.

My usually astute reporter's mind becomes as foggy as San Francisco Bay when I attempt to recall the events that followed. I do remember being herded with the others (you could recognize our group—we were the ones wearing straw hats with Apple logos on them), into some sort of cabaret on Green Street: Club Fugazi, it was called, and that's about the last hard fact I remember. The Guinness Stout I had been drinking and the extremely bizarre floor show then combined to cause my amnesia. The Queen of England was there, I remember, carrying a purse six feet long and wearing a box of Imperial Margarine on her head. Perhaps I should discontinue this train of thought.

The next morning, the somewhat haggard hack troops assembled quietly and without much esprit. That is until the sight of 40 fully-configured IIes began to perk them up. Apparently not even several hangovers could dilute the enthusiasm these folks felt for the hardware.

Sunday morning 40 IIe systems were available for "hands-on." Despite the toll of the previous night, enthusiasm prevailed.

That kind of loyalty can be found only in a die-hard user's group. It certainly bodes well for Apple to cultivate that loyalty, now and for the future. And the International Apple Core should be proud of the company it supports; Apple has set a fine precedent by supporting the IAC in this manner. I heard complaints about Apple during my time in Santa Clara, but none pertaining to the IIe Conference itself. It was a gracious and thoughtful christening for the new machine. □

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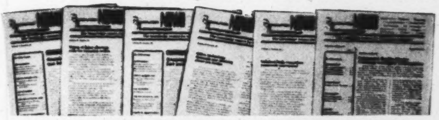

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CIRCLE 147 ON READER SERVICE CARD

outpost: atari

John J. Anderson

One of the cardinal rules I set for myself when I started writing the Outpost was never ever to report unconfirmed rumors. I am now going to enthusiastically break that rule, for the following reasons. First of all, the news is from an extremely reliable source: probably the best source I have. Unimpeachable, you might say. Second, the news is good. The news is really very good. It has got to be the best bit of Atari news I've heard in—jeepers—quite a while.

Scuttlebytes

If you have been following this column for the last three months or so, you know of my deep disappointment with the new 1200 machine. I, and many other Atari computer loyalists along with me, have felt that the 1200 XL was not only lackluster, but actually served to point the Atari Home Computer Division in a weak and uncompetitive direction. During my somewhat petulant visit to Sunnyvale some months ago, Atari voiced a commitment to at least listen to user suggestions concerning a redesign. I then made an effort to get everyone in the world who cares to help set Atari straight.

Well Atari has not only listened, but actually seems to have come around. It seems that the model 1200 redesign will be as extensive as we all hoped. Among other reforms, there will be a return to the *compatible operating system* of the 400 and 800; also, and brace yourself, an *expansion chassis* feature will be available. Seems almost too good to be true.

All I can say is yippee, yahoo, and thank the Lord above. I hope to report some very good news in next month's Outpost, detailing the enlightened features to be included in the redesign of the Atari 1200. I hope also to report on a batch of *new, compatible* Atari computers. If you are among the concerned Atarians that have made your feelings known to Atari, there is real cause to rejoice — you got through. My great thanks to all of you.

The last two columns of the Outpost have generated lots of mail, so I shall try to steer clear of further controversy this time around. We'll meet a real up-and-comer in the Atari software market, and also examine the full listing of a remarkable self-modifying title card generator, sent to us as an entry in our program contest.

A couple of quick comments about the mail before we get started. I cannot possibly answer all your letters individually. If you must have a personal response, please enclose a self-addressed, stamped envelope with your letter. That is about the only way you will hear from me. I still encourage you to keep the cards and letters coming in, especially those concerned with the future of Atari microcomputers.

I do hope you are letting Atari know your feelings too, though, and not just me. Let them know you are out there, and that you care enough to have gotten in touch.

Dewey Unto Others

I have visited quite a few fledgling software concerns in my time and met some interesting people. Many of them talk a literally "good game"; fewer can then back up their talk with original, high quality software. And in the area of educational packages, well, I don't have to remind you how many just plain lousy programs there are to be found hiding under a hat of high mindedness. Some established and well-advertised third-party education stuff for the Atari ranks among the most amateurish swill on the market today.

Coming to microcomputing from the field of education, as I do, that fact is especially lamentable to me. It makes it much harder to convince people of the power of computer graphics and sound as educational entertainment tools. As a result, the division between educational and entertainment software is strengthened in many minds. That's too bad, since to my mind there should be no such division.

When the rare somebody comes around who is really on the beam, therefore, it is especially exciting to me.

Trip Hawkins of Electronic Arts in San Mateo, CA, is one of these rare souls. He expounds the virtues of microcomputer games in education in much

Trip Hawkins, of Electronic Arts, with Pinball Construction Set.

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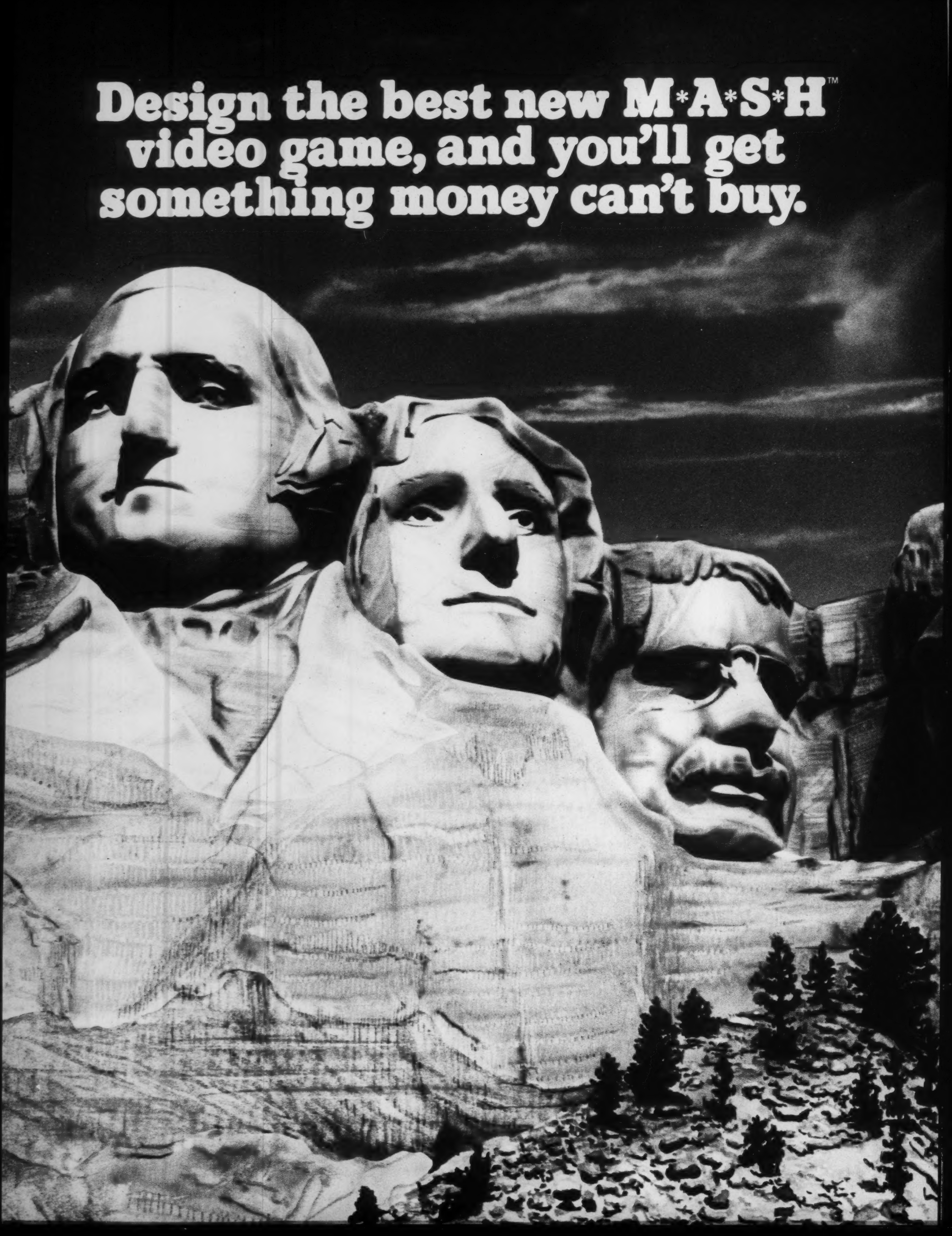
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Outpost: Atari, continued...

the way that I do, even to the point of invoking the name of John Dewey in the process. And any friend of John Dewey is a friend of mine.

If you ever get the chance to discover the writings of John Dewey, I wholeheartedly encourage you to do so. His thinking has done much for the philosophy of education in this country. Within his many sensible and sensitive writings, he repeatedly expressed the belief that the best kind of learning involves the learner as active *participant*—that it is much more potent to *experience* as opposed to merely hear about a subject. If Dewey had lived into the microcomputer age, I am sure he would have advocated the use of the personal computer as a perfect tool to advance this kind of learning.

The vital difference between Trip Hawkins and many others who share Dewey's viewpoint is that Mr. Hawkins is actively pursuing the goal and amassing products consistent with it to inaugurate his software label. Make note of that name, *Electronic Arts.* It may well set the standard for sophisticated entertainment software in the 80's.

Hawkins, who applied his estimable intellect for two years to the development of the Lisa machine at Apple, clearly and unequivocally sees the microcomputer as a new artistic medium. The computer offers the potential for incredibly complex forms of entertainment that are at the same time extremely simple to play. "Hidden scaffolding" is the term Hawkins uses to describe the means by which a computer program can encompass more depth and realism than anything yet seen in the genre.

He sees it as the job of a software house such as his own to find, manage, and support software artists, in much the same way that a good film studio or record label would handle its performers. In fact, he intends to use some of the artists who do record album covers to aid in the packaging of Electronic Arts software.

Trip sees the contemporary microcomputer software business in a situation similar to the situation the film industry experienced back in the 1900's—at the very outset of its development. A great deal of software has derived appeal from sheer novelty, rather than content, and hundreds of folks from every walk of life are feverishly churning the stuff out; most of it is mediocre. But this is changing fast. The sophistication of the software buyer grows daily.

Carrying forth that analogy, Hawkins sees as his task the creation of an environment wherein a "software

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Charlie Chaplin" can arise. This means support in terms of development, marketing, and public relations. Hawkins believes that software artists well deserve celebrity, and will soon be as famous as artists in any other medium. Sounds good to me, and certainly on the right track.

Terrific talk, granted. But what about the products? Well here are some of the top-quality Atari titles to look for from Electronic Arts:

Archon, a fantasy "board" game combines strategic elements of chess with adventure fantasy. Quality microcomputer games offering competition between two human players are few and far between. *Archon* involves competition for power points on a board where the color of the squares can change, depending on strategic factors. Conflict zooms to a close-up on the confrontation square, where players pit various joystick-controlled creatures against each other. This is the kind of game I have been waiting to see for the Atari, and even if you haven't, you are bound to fall for it. Imagine a chess game in which you can cast spells . . .

M.U.L.E. stands for "multiple-use labor element," and it is the basic play component in the game of the same name, which is somewhat like the board games Diplomacy or Monopoly. In it, up to four players find themselves competing for financial advantage on a foreign planet. While shrewd bargaining and dexterous joystick competition are called for, players must also cooperate to survive various crises. The graphics, sound, and humor in this game are superlative, and though the kids won't suspect it in the least, they'll be learning laws of economics as they play. It is a multiplayer game that even adults will want to come back to—and handicaps are available to even out the abilities of adults and children. After a few dozen games even adults will turn to the manual accompanying *M.U.L.E.* to get some background on the laws of supply and demand. And the animated characters in the game are thoroughly adorable.

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Worms? is one of those games like Conway's game of Life, that in execution of colorful animated graphics, gives the player an intuitive feeling for hitherto unseen mathematical relationships. One round of the game, which embodies some of the best graphics and sound to be seen on Atari, will have you thinking of the mother ship in *Close Encounters.*

Players "train" streaks of light to move in patterns from one dot to another in a black background matrix. Every player has his own color, and every direction has its own musical tone. To score points, complete all the possible junctions on a node. Soon the screen is alight with tuneful worms marching by "decision points" to the beat of their respective drummers. The game holds a lasting and nearly hypnotic fascination. Winning worm patterns can be made to compete against new computer- or human-generated opponents. There is a deep satisfaction to be gleaned from *Worms?*, in seeing and hearing the harmonies of pattern. Dewey would have loved playing this one.

Pinball Construction Set is a tour de force by Bill Budge, who is quite arguably the Charlie Chaplin of microcomputing. Originally designed and marketed for the Apple computer, the Atari version includes several improvements not present in the original game. In the latest issue of *Video and Arcade Games,* I reviewed the Apple version, stating that the only thing conceivably more enjoyable than playing Budge's micro-pinball is creating your own micro-pinball machines. *Pinball Construction Set* makes doing so a joy, and to that end uses an icon-based menu system quite similar to the Apple Lisa's "mouse". Want to add a bumper or flipper? Use the joystick-controlled pointer to "pick it up" from the icon chart, and place it anywhere you please in your own pinball machine. Then save your creation to disk as a fully functional, stand-alone microcomputer pinball game. If you don't quite buy the versatility of mouse-based systems, this program is required booting for you. Bill Budge is an example of the caliber of software artist Electronic Arts seeks to solicit.

Watch your local software store, or contact Electronic Arts, 2755 Campus Dr., San Mateo, CA 94403. And other software houses, make note, take heed, watch out.

Title Bout

Ever since the first entries came in, I have been collecting features to include in a deluxe version of the Title Card Generator contest program begun early this year. My original plan was to combine as many features as possible into one big program, to be printed in its entirety this month. Then Kelly Phillips came along.

What Kelly did was to submit a program that took my original ideas and moved them in an entirely new direction, adding features that I hadn't believed possible, and saving screens in an entirely new manner. So instead of printing a mishmash of routines from many different programs, it is my pleasure to present in its entirety his superlative version of a self-modifying title generator program.

Mr. Phillips trades off some of the features I considered neat about my approach, such as sound, and the ability to watch each letter plot itself on the screen one at a time. But the rewards he reaps are fantastic. The most impressive is the scaling feature—the point size of the font is made user-programmable. This idea had, in fact, crossed my mind during a stray moment in first developing the super character set, but I had jettisoned it immediately, thinking the allied problems would be insurmountable. For me, I'm sure they would have been.

If you typed in the original program, you owe it to yourself to make Kelly Phillips's additions. If you never typed the original, an entire listing is presented here, and I guarantee that once you see the kinds of things you can do with it, you will want to use it to generate titles for all your own programs.

And so I shall hand the reins over so Kelly can take you through the program. If you wish to communicate directly with him, he can be reached at 346 West 400 North, Logan, UT 84321.

* * *

This version of John Anderson's "Self-Modifying Title Card Generator" is an expanded version of the one that appeared in the February 1983 issue of *Creative Computing.* It provides all of the features of the original program (except sound), and adds many more advanced and useful functions such as scaling and freehand joystick control. With the additional features of this version of the title card generator, you can easily make your own screen creations much more colorful and professional looking. In reading the following documentation, I suggest that you refer to Mr. Anderson's original article as well

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TRIGA COMMAND

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CIRCLE 167 ON READER SERVICE CARD

as the headings that follow *Cursor Movement Controls* and *Control Commands* that follow.

Typing the Program

The title card generator is numbered in increments of ten for ease of entry. It was also designed to be added to the original version with minimal modification. If you already have the original program, load it and make the following changes: delete lines 160-230 and line 859. Change the DATA in line 1000 from END to R. Type in the NEW sections of the program (lines 0-150 and lines 2000-3040 of Listing 1). Do not change the line numbering in any way, and be especially careful when typing lines 3120-3340. This is crucial to the proper operation of the program. At this point, you should *save the program* on cassette or disk *before running it.* When the program is run, it will delete major portions of itself, so you will need to have that complete copy saved prior to any program run.

If you do not have a copy of the original program, a full listing of my modifications appears here as Listing 1.

The title card generator is a program that is used to enable the computer to actually "write" another shorter program which will be used for your title card display from that time on. It consists of two major phases: 1) the editing phase, in which you create the screen that you wish to have the computer incorporate into the program it will write, and 2) the program creation phase, in which the computer saves your screen along with some Basic commands for your title program to use later on.

These Basic commands will also be chosen by you—based on your answers to a few simple questions during this phase. At that time, the company will also delete the actual title card creation portion from memory, since it will not be needed in the display program that the computer writes.

The "cursor" in the title card generator is a multi-colored flashing square which appears in the center of the screen. Unlike the original version of the title card generator, the cursor is by no means bound to three rows of seven columns each. You have complete control to put the letters anywhere on the screen, and then mix them up with borders, designs, or anything else you can dream up. In addition, the letters may be of almost any size you choose. For more information on the commands which change the cursor position, see the heading entitled *Cursor Movement Controls* up ahead.

Getting Letters on the Screen

To draw a letter on the screen, simply press the letter you wish to draw. Letters are always drawn with their top left edge at the current cursor position. The cursor will then automatically be moved to the next letter position, just like a super large text typing mode. If there is not sufficient room to draw a letter at the position at which you attempt to do so, you will hear a buzzer and the command will be ignored. You will also hear the buzzer if you issue a command that the title generator does not understand. Faulty commands will also be ignored.

Using the Joystick

In addition to automatically drawing letters on the screen and using the 12 control commands, you may use the joystick to draw any free-hand design you wish. To draw with the joystick, hold the red button down while moving the stick in the desired direction. If the joystick is moved without the red button depressed, the cursor will move, but nothing will be drawn. The joystick should be plugged into port number one, and may be used at any time during your screen editing (except when a control command is in progress).

"Your access code Tom! Input your access code!!"

Saving Your Screen

Pressing CONTROL-Q allows you to save your screen with a smaller title card display program that the computer will actually write to your specifications, based on your answers to a few questions. This process requires quite a bit of time, because the computer goes through many steps to write the display program.

The computer can create this program on cassette or disk, but keep in mind that you must have sufficient room to do so. For a disk, you will need at least 250 free sectors, and for cassette at least a 60-minute tape. This is your responsibility as the program does *not* check for sufficient room before starting the saving process. Following is a short explanation of the questions the computer asks before the saving gets under way, and what it expects for an answer.

WOULD YOU LIKE TO SAVE THIS SCREEN? This is to verify that you meant to press CTRL-Q. If you answer Y, the following additional questions will be asked. If you answer N, you will be returned to your screen just where you left off.

SAVE TO (1) CASSETTE OR (2) DISKETTE? This allows you to save the display program to either cassette or disk. Press 1 for cassette or 2 for disk.

TEXT WINDOW SECONDARY MESSAGE? You will be asked this question only if you have enabled the text window display with CTRL-T. If you have, you should now type in up to four lines of text that you want to appear in the text window of your display program. Each line may consist of no more than 38 characters.

SPECIAL EFFECTS? Here you may choose which type of special effect you wish to have in your display program. Effect #1 is the rainbow effect, as it was used in Mr. Anderson's original program. This effect causes all portions of your picture which are colored with pen #1 to cycle through the 128 Atari color variations.

Effect #2 is the flash effect which will cause all portions of your picture colored with pen #1 to flash on and off in your display program. Effect #3 is the random effect. This effect will cause *all* the colors on your picture to change randomly in your display program. To select a special effect, type the number corresponding to it. If you do not wish to have any special effects, simply press RETURN.

WHAT TYPE OF PLOTTING WOULD YOU LIKE? Pressing a 1 here will create

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CIRCLE 125 ON READER SERVICE CARD

your program in such a way that the screen will be invisible until it is drawn. Then the whole screen design will be turned on at once. Pressing a 2 allows the picture to be seen the whole time it is being drawn.

CHAIN TO ANOTHER PROGRAM? If you are saving to cassette, you will *not* be asked this question. For disk users, this will allow you to have your title card display the title of a program, and then subsequently run that program automatically.

ENTER A FILE NAME FOR THIS PROGRAM? If you are saving to cassette, you will not be asked this question either. This is because the cassette does not recognize file names when saving programs. For disk users, this is where you will type the name you wish to use for your display program. Note that this is different from the previous question in that it names the display program itself, whereas the previous question provided a name that the display program could chain to if desired.

At this point, you insert the desired cassette or disk, and the computer creation process begins. Several functions are performed here. First, the screen data are saved in the form of Basic DATA statements. On disk, the file name is SCREEN.DAT. When complete, the screen data are re-entered into memory and many of the original program lines are deleted. Then portions of the display program are generated, based on your answers to the previous questions. When all these functions are complete, the program saves your new display program, returns to Graphics 0, and ends. You may now run your title display program and see how it looks. (During the saving process, cassette users should pay attention to the screen to see when to rewind the tape and when to press RETURN to save and re-enter portions of the program as needed.)

Programming Notes

From time to time, my Atari has had the problem of "keyboard lockup" during the computer creation phase. This is apparently due to the fact that many program lines are deleted, added, and edited. For some reason, the Atari may lock up, with no recourse except to turn off the computer. The title card generator was programmed with this problem in mind. Delays were strategically placed wherever a screen full of line numbers is to be deleted. This is to give the Atari time to re-arrange its memory fully before more deletions come.

But, should your computer lock up, fear not, your screen is still intact and safely saved in a file on disk or cassette. To retrieve it, turn off the computer for a while, then turn it back on and LOAD the title generator. Next, type: ENTER "D:SCREEN.DAT" (or ENTER "C:" for cassette). This will re-enter your screen data. Then type: 2025 GOSUB 100. You may now run the program, and you will be in the editor, ready to attempt the SAVE process again.

You may begin at that point and nothing will be lost. This may be repeated as many times as the problem persists, and no harm will be done to your masterpiece. The program does not delete the screen data from cassette at all and only deletes it from disk when all other functions are complete and successful.

Another problem was the speed at which Atari Basic could analyze and save the exact data currently on the screen. The screen saving routine was placed at the beginning of the program (lines 2-8), which approximately doubles the speed of this lengthy process.

Program Remarks

To keep the program as short as possible, the REMARK statements were left out in the final version of the title card generator. Figure 1 is a line by line description which may be used to follow the flow and design of the program.

Cursor Movement Controls

Figure 2 lists 11 special cursor movement keys that are available in the title generator. They allow you to move very small distances for greater accuracy or very large distances for greater speed.

Control Commands

There are 12 control commands available in the title generator. These commands allow you to manipulate the screen in several ways. The commands are invoked by holding down the CONTROL key while pressing the desired command letter. The only exception is the screen clear command, which is invoked with the SHIFT key instead. Following is a description of the intended use for each of the control commands and program "default" conditions where applicable.

Save screen data	2-8
Program skeleton	10-150
Letter data	650-1000
Rainbow routine	1010-1050
Initialization	2000-2020
Poll keys and stick	2030-2120
Cursor movement	2130-2240
Draw a border	2250
Change pen colors	2260-2350
Position cursor	2360-2390
Erase a letter	2400
Fill toggle	2410
Change pens	2420-2450
Set the scaling	2470-2500
Set text window	2510-2530
View coordinates	2540-2560
Quit, no save	2570
Draw letters	2590-2690
Buzzer	2700
Save verify	2710-2740
Cassette, disk	2750-2770
Text message	2790-2820
Special effect	2830-2890
Plot type	2900-2920
Create chain	2940-3000
Key in name	3010-3040
Delete data	3120-3160
Create skeleton	3170-3260
Delete utility	3270-3280
Save program	3290-3310
Delete routine	3320-3340

Figure 1.

SHIFT-CLEAR: Clears the screen and resets all parameters to their default settings.

CONTROL-B: Draws a border from the

Key Pressed	Cursor Moves
Spacebar	Right one letter position
Delete key	Left one letter position
Return key	Left of screen, down one letter
Right arrow	Right one pixel
Left arrow	Left one pixel
Up arrow	Up one pixel
Down arrow	Down one pixel
Shift right arrow	Right five pixels
Shift left arrow	Left five pixels
Shift up arrow	Up five pixels
Shift down arrow	Down five pixels

Note: To use the cursor movements with the arrow keys, *do not* press the CONTROL key at the same time. The arrows should be pressed alone (except those specifying the SHIFT key). Thus, the actual keys pressed are -, =,+, and * for the unshifted arrows, and _,:, \, and ∧ for the shifted arrows.

Figure 2.

◇ indicates price decrease
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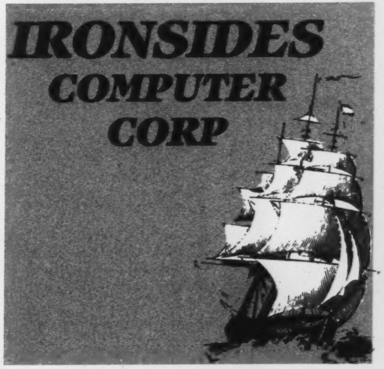

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Outpost: Atari, continued...

current cursor position and centers it on the screen based on the cursor coordinates.

CONTROL-C: Sets the colors for each of the four "pens" available in the title generator. Equivalent to the Atari Basic SETCOLOR statement. Default setting is the same as the standard Atari default colors.

CONTROL-D: Direct cursor positioning. Places the cursor at the exact X and Y coordinates specified by the user. Equivalent to the Atari Basic POSITION statement.

CONTROL-E: Erases a letter-sized block. The cursor is placed at the top left of the letter to be erased, then CONTROL-E is pressed, erasing the letter (and everything else in its path, so be careful).

CONTROL-F: Fill toggle. Toggles the letter fill feature from on to off and vice versa. When the fill command is enabled, letters are filled with the color of pen #1. Default=fill on.

CONTROL-P: Selects the pen to draw with. There are three colored pens (1-3) and one "erase" or background colored pen (pen 0). Equivalent to the Atari Basic COLOR statement. Default pen=2.

CONTROL-Q: Quits and saves the screen. Ends the editing phase and prepares for creating the title display program.

Listing 1.

```
0 GOTO 2000
2 ? CHR$(125);"           CREATING SCREEN DATA ":? :? "           PLEASE STA
ND BY.";:K=650:FOR I=0 TO RMAX
4 POKE 77,0:POKE 656,3:POKE 657,33:? "ROW ";I;:FOR J=0 TO 159:LOCATE J,I,Z:Z=Z+6
4:IF Z=64 THEN Z=68
6 A$(J+1,J+1)=CHR$(Z):NEXT J:IF A$=B$ THEN NEXT I:CLOSE #2:? CHR$(125):K=K+2:RET
URN
8 ? #2;K;" DATA ";I;",";A$(1,80):? #2;K+1;" DATA ";A$(81,160):K=K+2:NEXT I:CLOSE
 #2:? CHR$(125):K=K+2:RETURN
10 DIM A$(80),B$(80)
20 GOSUB 100
100 GRAPHICS 23
120 RESTORE 650:TRAP 140
130 READ ROW,A$,B$:POSITION 0,ROW:? #6;A$;B$:GOTO 130
140 REM
150 RETURN
650 REM "A"---------------------------
652 DATA R,0,0,S,0,1
654 DATA P,2,7,2,13,4,16,6,18,8,19,25,19,25,13,F,19,13,P,6,9,F,6,11,F,7,12,F,8,1
3,F,13,13,13,7
656 DATA 8,7,7,8,6,9,P,19,13,19,7,25,7,25,1,F,8,1,F,6,2,F,4,4,F,2,7,2,13,P,13,7,
8,7,7,8,6,9
660 REM "B"---------------------------
662 DATA R,0,22,S,1,7
664 DATA P,2,1,2,13,4,16,6,18,8,19,10,19,12,17,13,15,15,17,17,19,21,19,23,17,25,
15,25,1
666 DATA P,6,7,F,6,11,F,8,13,F,10,11,10,7,6,7,P,15,7,F,15,11,F,18,13,F,20,11,20,
7,16,7,P,25,1,F,2,1
670 REM "C"---------------------------
672 DATA R,0,44,S,2,11
674 DATA P,2,7,2,13,4,16,6,18,8,19,8,13,F,6,11,F,6,9,8,7,19,7,21,9,P,19,19,21,19
,23,16,25,13
676 DATA P,21,9,F,21,11,F,19,13,19,19,P,25,13,25,7,F,23,4,F,21,2,F,19,1,F,8,1,F,
6,2,F,4,4,F,2,7
680 REM "D"---------------------------
682 DATA R,0,66,S,3,13
684 DATA P,2,1,2,13,4,16,6,18,8,19,17,19,21,19,23,17,25,15,25,1,P,6,7,F,6,11,F,8
,13,F,18,13,F,20,11,20,7,6,7
686 DATA P,25,1,F,2,1
690 REM "E"---------------------------
692 DATA R,0,88,S,0,15
694 DATA P,2,1,2,19,8,19,8,7,11,7,11,15,16,15,16,7,19,7,19,19,25,19,25,1,F,2,1
```

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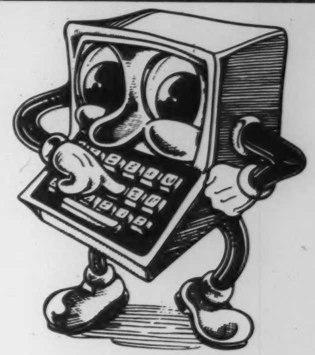
CIRCLE 173 ON READER SERVICE CARD

```
700 REM "F"---------------------------
702 DATA R,0,110,S,1,18
704 DATA P,2,1,2,19,8,19,8,7,11,7,11,15,16,15,16,7,25,7,25,1,F,2,1
710 REM "G"---------------------------
712 DATA R,0,132,S,2,23
714 DATA P,2,7,2,13,4,16,6,18,8,19,8,13,F,6,11,F,6,9,8,7,19,7,21,9,P,19,19,21,19
,23,16,25,13
716 DATA P,18,19,14,19,14,11,F,18,11,F,18,13,F,19.13,F,21,11,21,9
718 DATA P,25,13,25,7,F,23,4,F,21,2,F,19,1,F,8,1,F,6,2,F,4,4,F,2,7
720 REM "H"---------------------------
722 DATA R,25,0,S,3,28
724 DATA P,2,13,2,19,25,19,25,13,F,16,13,P,2,7,11,7,F,11,13,F,2,13,P,16,13,16,7,
25,7,25,1,F,2,1,2,7
730 REM "I"---------------------------
732 DATA R,25,28,S,0,31
734 DATA P,2,1,2,7,25,7,25,1,F,2,1
740 REM "J"---------------------------
742 DATA R,25,44,S,1,38
744 DATA P,2,13,2,19,20,19,21,18,23,16,25,13,25,7,P,2,13,F,18,13,F,20,12,F,21,9,
19,7,F
746 DATA 19,1,F,20,1,F,22,2,F,23,4,F,25,7
750 REM "K"---------------------------
752 DATA R,25,66,S,2,42
754 DATA P,2,1,2,7,11,7,P,19,19,13,14,8,19,2,19,2,13,F,8,13,F,11,7,P,19,19,25,19
,25,13,F,19,13,F,16,7,25,7
756 DATA 25,1,F,2,1
760 REM "L"---------------------------
762 DATA R,25,88,S,3,47
764 DATA P,2,1,2,7,19,7,19,19,25,19,25,1,F,2,1
770 REM "M"---------------------------
772 DATA R,25,110,S,0,57
774 DATA P,2,1,2,7,5,10,2,13,2,19,25,19,25,13,F,10,13,13,10,F,10,7,25,7,25,1,F,2
,1,2,7,6,10,F,4,11,F,3,12,F,2,13
780 REM "N"---------------------------
782 DATA R,25,132,S,1,63
784 DATA P,2,1,2,7,8,13,2,13,2,19,25,19,25,13,F,19,13,F,13,7,25,7,F,25,1,F,2,1,2
,7,9,13,F,2,13
790 REM "O"---------------------------
792 DATA R,50,0,S,2,76
794 DATA P,2,7,2,13,4,16,6,18,8,19,19,19,21,18,23,16,25,13,P,8,7,6,9,F,6,11,F,8,
13,F,19,13,F,21,11,21,9,19,7,8,7
796 DATA P,25,13,25,7,F,23,4,F,21,2,F,19,1,F,8,1,F,6,2,F,4,4,F,2,7
800 REM "P"---------------------------
802 DATA R,50,22,S,3,86
804 DATA P,2,1,2,13,4,16,6,18,8,19,13,19,15,18,17,16,19,13,P,6,9,F,6,11,F,7,12,F
,8,13,F,13,13,13,7
806 DATA 8,7,7,8,6,9,P,19,13,19,7,25,7,25,1,F,2,1
810 REM "Q"---------------------------
812 DATA R,50,44,S,0,96
814 DATA P,2,7,2,13,4,16,6,18,8,19,19,19,21,18,23,16,P,8,7,6,9,F,6,11,F,8,13,F,1
9,13,F,21,11,21,9,19,7,8,7
816 DATA P,23,16,27,19,29,16,F,25,13,F,25,7,F,23,4,F,21,2,F,19,1,F,8,1,F,6,2,F,4
,4,F,2,7
820 REM "R"---------------------------
822 DATA R,50,66,S,1,103
824 DATA P,2,1,2,13,4,16,6,18,8,19,10,19,12,17,13,15,15,17,17,19,25,19,25,13
826 DATA P,6,7,F,6,11,F,8,13,F,10,11,F,10,7,6,7
828 DATA P,25,13,F,22,13,F,19,12,F,18,9,18,7,25,7,25,1,F,2,1
830 REM "S"---------------------------
832 DATA R,50,88,S,2,115
834 DATA P,2,7,2,13,4,16,6,18,8,19,8,13,F,6,11,6,9,8,7,10,9,10,13,12,16,14,18,16
,19
836 DATA 19,19,21,18,23,16,25,13,25,7,P,17,7,19,9,F,19,11,F,17,13,F,15,11,F,15,9
838 DATA P,25,13,F,25,7,F,23,4,F,21,2,F,19,1,F,17,1,17,7,P,15,9,F,14,7,F,12,4,F,
10,2,F,8,1,F,6,2,F,4,4,F,2,7
840 REM "T"---------------------------
842 DATA R,50,110,S,3,128
844 DATA P,2,1,2,19,8,19,8,13,25,13,25,7,F,8,7,8,1,F,2,1
850 REM "U"---------------------------
852 DATA R,50,132,S,0,146
854 DATA P,2,13,2,19,19,19,21,18,23,16,25,13,25,7
856 DATA P,2,19,2,13,19,13,F,21,11,21,9,19,7,2,7,2,1,P,25,7,F,23,4,F,21,2,F,19,1
,F,2,1
858 DATA P,20,13,F,2,13
860 REM "V"---------------------------
862 DATA R,35,25,S,0,153
864 DATA P,2,1,2,7,14,7,16,9,16,11,14,13,2,13,2,19,17,19,25,11,F,25,9,F,17,1,F,2
,1
866 DATA P,16,9,F,16,11,F,14,13,F,2,13
870 REM "W"---------------------------
872 DATA R,35,47,S,1,172
874 DATA P,2,1,2,7,19,7,16,10,19,13,2,13,2,19,25,19,25,13,F,22,10,25,7,25,1,F,2,
1
876 DATA P,16,10,F,19,7,P,2,13,F,19,13
880 REM "X"---------------------------
882 DATA R,35,69,S,2,191
884 DATA P,2,1,2,7,9,10,2,13,2,19,8,19,13,15,19,19,25,19,25,13,F,18,10,25,7,25,1
,F,18,1,F,13,5,F,8,1,F,2,1
886 DATA P,10,10,F,2,13
890 REM "Y"---------------------------
892 DATA R,35,91,S,3,205
894 DATA P,2,1,2,7,9,10,2,13,2,19,8,19,13,15,16,13,25,13,25,7,F,16,7,F,13,5,F,8,
1,F,2,1
```



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Outpost: Atari, continued...

CONTROL-S: Sets the scaling factor with which the letters will be drawn. The factor must be no less than 0.25 and no more than 3.5. Some scaling factors may cause the fill feature to be inaccurate. Default scale=1.

CONTROL-T: Text window toggle (on/off). Enables (Graphics 7) or disables (Graphics 7 and 16) the four-line text window at the bottom of the graphics screen. Default= text window off.

CONTROL-V: View the current X and Y coordinates. The column (X) and row (Y) coordinates are shown in the text window. Pressing any key returns to normal editing.

CONTROL-Z: Ends the program with no save. Ends the program completely, returns to Graphics 0, and *does not* invoke the screen saving routine.

Also note that control commands C, D, P, Q, S, V, and Z set the colors to the Atari default conditions while in progress. This is to ensure that all of the text prompts used in these commands will be visible in the text window, regardless of the actual colors selected for the screen display. At the conclusion of these commands, the colors will be set back to those specified by the user.

* * *

So there you have it. One addition you might want to make to Kelly's program is a fix to clip screen edge parameters. As it now stands, cursor movement off the usable screen will result in an error, blowing up whatever you are working on. I made a quick fix when first alerted to the problem by adding a TRAP and some clippers as shown in Figure 3. Because line 2100 is already at the maximum program line length, you'll need to split it, creating line 2105 in the process. As I say, this was a quick fix, I'm sure you can do better.

I know I had promised more for this month, but space considerations preclude anything else this time around. Next month, I promise we will address new software and hardware topics, as well as compacting data into graphics characters. Until then, keep up your computing . . ☐

```
2082 IF X<0 THEN X=1
2084 IF X>159 THEN X=158
2086 IF Y<0 THEN Y=1
2088 IF Y>95 THEN Y=94

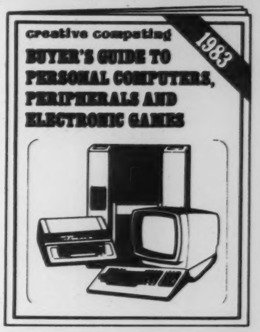
2100 TRAP 2082:X=X+(S=5 OR S=6
     OR S=7)-(S=9 OR S=10 OR
     S=11):Y=Y+(S=5 OR S=9 OR
     S=13)-(S=6 OR S=10 OR
     S=14)
2105 LOCATE X,Y,Z
```

Figure 3. Lines to add for screen clipping. Addition of the TRAP to line 2100 necessitates splitting it into 2100 and 2105.

```
896 DATA P,10,10,F,2,13
900 REM "Z"------------------------------
902 DATA R,35,113,S,0,255
904 DATA P,2,1,2,19,8,19,19,10,19,19,25,19,25,1,F,19,1,F,8,10,8,1,F,2,1
1000 DATA R
1010 RESTORE 1040
1020 FOR I=1 TO 32:READ C:C$(I)=CHR$(C):NEXT I
1030 RETURN
1040 DATA 104,104,104,72,162,57,160,0,173,0,210,101,20,141,22,208,141,10,212,136
,208,242,202,208,237,104
1050 DATA 56,233,1,208,228,96
2000 CLR :GRAPHICS 23:DIM A$(160),D$(3),B$(160),TW$(152),F1$(15),F2$(15),S(7)
2010 B$(1,1)="D":B$(160,160)="D":B$(2)=B$:TW$(1,1)=" ":TW$(152,152)=" ":TW$(2)=T
W$:X=79:Y=39
2020 C1=40:C2=202:C3=148:C4=0:C5=0:PEN=2:SS=16:RMAX=95:SCALE=1:FILL=1:POKE 65,0:
CLOSE #1:OPEN #1,4,0,\K:"
2030 POKE 708,C1:POKE 709,C2:POKE 710,C3:POKE 712,C4:POKE 77,0:POKE 764,255
2040 X=INT(X+0.5):Y=INT(Y+0.5):LOCATE X,Y,Z
2050 K=PEEK(764):S=STICK(0):IF S<>15 OR K<>255 THEN 2080
2060 C=C+1:IF C>4 THEN C=1
2070 COLOR C:PLOT X,Y:FOR I=1 TO 5:NEXT I:GOTO 2050
2080 IF K<>255 THEN 2120
2090 COLOR PEN:PLOT X,Y:IF STRIG(0)=1 THEN COLOR Z:PLOT X,Y
2100 X=X+(S=5 OR S=6 OR S=7)-(S=9 OR S=10 OR S=11):Y=Y+(S=5 OR S=9 OR S=13)-(S=6
 OR S=10 OR S=14):LOCATE X,Y,Z
2110 GOTO 2050
2120 GET #1,KEY:IF KEY>64 AND KEY<91 THEN 2590
2130 COLOR Z:PLOT X,Y:IF KEY=125 THEN 2000
2140 IF KEY=32 THEN X=X+(SCALE*22)*(X<160-SCALE*22):GOTO 2030
2150 IF KEY=126 THEN X=X-(SCALE*22)*(X>=SCALE*22):GOTO 2030
2160 IF KEY=155 THEN X=999:GOTO 2630
2170 IF KEY=42 THEN X=X+(X<159):GOTO 2030
2180 IF KEY=43 THEN X=X-(X>0):GOTO 2030
2190 IF KEY=61 THEN Y=Y+(Y<RMAX):GOTO 2030
2200 IF KEY=45 THEN Y=Y-(Y>0):GOTO 2030
2210 IF KEY=94 THEN X=X+5*(X<155):GOTO 2030
2220 IF KEY=92 THEN X=X-5*(X>4):GOTO 2030
2230 IF KEY=124 THEN Y=Y+5*(Y<RMAX-4):GOTO 2030
2240 IF KEY=95 THEN Y=Y-5*(Y>4):GOTO 2030
2250 IF KEY=2 THEN COLOR PEN:PLOT X,Y:DRAWTO 159-X,Y:DRAWTO 159-X,RMAX-Y:DRAWTO
X,RMAX-Y:DRAWTO X,Y:GOTO 2030
2260 IF KEY<>3 THEN 2360
2270 GRAPHICS 39:POKE 752,1:? CHR$(125);"WHICH PEN WOULD YOU LIKE TO CHANGE ?":?
 :POKE 657,17:? "(0-3)"
2280 GET #1,KEY:IF KEY<48 OR KEY>51 THEN GOSUB 2700:GOTO 2280
2290 POKE 752,0:I=KEY-49:IF I<0 THEN I=4
2300 TRAP 2530:? CHR$(125);" ALL VALUES MUST BE FROM 0 TO 15. ":? :
? " COLOR";:INPUT C
2310 IF C<0 OR C>15 THEN GOSUB 2700:GOTO 2300
2320 POKE 656,2:POKE 657,24:? "BRIGHTNESS";:INPUT C6
2330 IF C6<0 OR C6>15 THEN GOSUB 2700:GOTO 2320
2340 ? CHR$(125):GRAPHICS 39+SS:POKE 708,C1:POKE 709,C2:POKE 710,C3:POKE 712,C4:
SETCOLOR I,C,C6
2350 C1=PEEK(708):C2=PEEK(709):C3=PEEK(710):C4=PEEK(712):GOTO 2030
2360 IF KEY<>4 THEN 2400
2370 TRAP 2370:GRAPHICS 39:? CHR$(125);"ENTER A COLUMN NUMBER (0-159)";:INPUT I:
IF I<0 OR I>159 THEN 2370
2380 ? :? "ENTER A ROW NUMBER (0-";RMAX;")";:INPUT J:IF J<0 OR J>RMAX THEN 2370
2390 POKE 752,1:? CHR$(125):X=I:Y=J:GRAPHICS 39+SS:TRAP 40000:GOTO 2030
2400 IF KEY=5 THEN COLOR 0:FOR I=Y TO Y+27*SCALE+0.5:PLOT X,I:DRAWTO X+18*SCALE,
I:NEXT I:GOTO 2030
2410 IF KEY=6 THEN FILL=ABS(FILL-1):GOTO 2030
2420 IF KEY<>16 THEN 2460
2430 GRAPHICS 39:POKE 752,1:? CHR$(125);" WHICH PEN WOULD YOU LIKE TO USE ?":? :
POKE 657,17:? "(0-3)"
2440 GET #1,KEY:IF KEY<48 OR KEY>51 THEN GOSUB 2700:GOTO 2440
2450 PEN=KEY-48:? CHR$(125):GRAPHICS 39+SS:GOTO 2030
2460 IF KEY=17 THEN 2710
2470 IF KEY<>19 THEN 2510
2480 GRAPHICS 39:? CHR$(125);"         SELECT A SCALING FACTOR ":? "    (S
CALE MUST BE FROM .25 TO 3.5)"
2490 ? :POKE 657,18:INPUT SCALE:IF SCALE<0.25 OR SCALE>3.5 THEN GOSUB 2700:GOTO
2480
2500 POKE 752,1:? CHR$(125):GRAPHICS 39+SS:GOTO 2030
2510 IF KEY<>20 THEN 2540
2520 SS=ABS(SS-16):RMAX=95:IF SS=0 THEN RMAX=79
2530 GRAPHICS 39+SS:POKE 752,1:GOTO 2030
2540 IF KEY<>22 THEN 2570
2550 GRAPHICS 39:POKE 752,1:? CHR$(125);"     CURRENT CURSOR COLUMN IS ";X:? :?
"      CURRENT CURSOR ROW IS ";Y;
2560 GET #1,KEY:? CHR$(125):GRAPHICS 39+SS:GOTO 2030
2570 IF KEY=26 THEN GRAPHICS 39:? CHR$(125);"            PRESS 'Y' TO QUIT":GET #1
,KEY:IF KEY=89 THEN GRAPHICS 0:END
2580 GRAPHICS 39+SS:GOSUB 2700:GOTO 2030
2590 COLOR Z:PLOT X,Y:COLOR PEN:RESTORE KEY*10+4:IF X>=159-SCALE*18 OR Y>RMAX-SC
ALE*27 THEN GOSUB 2700:GOTO 2030
2600 READ D$:IF ASC(D$)<64 THEN ROW=VAL(D$):READ COLUMN:GOSUB 2690:DRAWTO COLUMN
,ROW:GOTO 2600
2610 IF D$="P" THEN READ ROW,COLUMN:GOSUB 2690:PLOT COLUMN,ROW:GOTO 2600
2620 IF D$<>"R" THEN 2650
2630 X=X+22*SCALE:IF X>159 THEN X=0;Y=Y+27*SCALE:IF Y>RMAX THEN Y=0
2640 GRAPHICS 39+SS:GOTO 2030
2650 IF D$="D" THEN 2600
```

```
2660 IF D$<>"F" OR FILL=0 THEN 2600
2670 READ ROW,COLUMN:GOSUB 2690:POSITION COLUMN,ROW:POKE 765,1
2680 XIO 18,#6,0,0,"S:":PLOT COLUMN,ROW:GOTO 2600
2690 ROW=INT((ROW*SCALE)+0.5)+Y-2*SCALE:COLUMN=INT((COLUMN*SCALE)+0.5)+X-1*SCALE
:RETURN
2700 FOR I=1 TO 3:SOUND 0,25,12,10:FOR J=1 TO 6:NEXT J:SOUND 0,0,0,0:FOR J=1 TO
3:NEXT J:NEXT I:RETURN
2710 GRAPHICS 39:POKE 752,1
2720 ? CHR$(125);"WOULD YOU LIKE TO SAVE THIS SCREEN ?":? :POKE 657,16:? "(Y OR
N)"
2730 GET #1,KEY:IF KEY<>78 AND KEY<>89 THEN GOSUB 2700:GOTO 2730
2740 IF KEY=78 THEN ? CHR$(125):GRAPHICS 39+SS:GOTO 2030
2750 ? CHR$(125);:POKE 657,16:? "SAVE TO:":? :? "    (1) CASSETTE    (2) DISKETT
E"
2760 GET #1,KEY:IF KEY<49 OR KEY>50 THEN GOSUB 2700:GOTO 2760
2770 DISK=0:IF KEY=50 THEN DISK=1
2780 IF SS=16 THEN 2830
2790 POKE 752,0:K=1:FOR I=1 TO 115 STEP 38
2800 ? CHR$(125);"  TEXT WINDOW SECONDARY MESSAGE ":? :? "LINE ";K;:
INPUT A$:J=INT((38-LEN(A$))/2)+I
2810 IF LEN(A$)>38 THEN ? CHR$(125):? "               LINE TOO LONG!";:GOSUB 27
00:FOR J=1 TO 300:NEXT J:GOTO 2800
2820 TW$(J,J+LEN(A$))=A$:K=K+1:NEXT I:POKE 752,1
2830 ? CHR$(125);"          SPECIAL EFFECTS ":? "(1) RAINBOW   (2) FLASH
   (3) RANDOM"
2840 ? :POKE 657,1:? "SELECT ONE OR PRESS  RETURN  FOR NONE.";
2850 GET #1,KEY:IF KEY=155 THEN 2900
2860 IF KEY=49 THEN RAINBOW=1:GOTO 2900
2870 IF KEY=50 THEN FLASH=1:GOTO 2900
2880 IF KEY=51 THEN RANDOM=1:GOTO 2900
2890 GOSUB 2700:GOTO 2850
2900 ? CHR$(125);"WHAT TYPE OF PLOTTING WOULD YOU LIKE?":? :? "    (1) INVISIBLE
     (2) VISIBLE"
2910 GET #1,KEY:IF KEY<49 OR KEY>50 THEN GOSUB 2700:GOTO 2910
2920 INVISIBLE=0:IF KEY=49 THEN INVISIBLE=1
2930 IF DISK=0 THEN 3060
2940 ? CHR$(125):? "     CHAIN TO ANOTHER PROGRAM ?":? :POKE 657,16:? "(Y OR N)"
2950 GET #1,KEY:IF KEY<>78 AND KEY<>89 THEN GOSUB 2700:GOTO 2950
2960 IF KEY=78 THEN 3010
2970 ? CHR$(125);"ENTER THE FILENAME (Dn:filename.ext)":? :? "FILE NAME: ";:POKE
 752,0:INPUT F1$:POKE 752,1
2980 ? CHR$(125);:POKE 657,(25-LEN(F1$))/2:? "IS '";F1$;"' CORRECT?":? :POKE 657
,16:? "(Y OR N)"
2990 GET #1,KEY:IF KEY<>78 AND KEY<>89 THEN GOSUB 2700:GOTO 2990
3000 IF KEY=78 THEN 2970
3010 ? CHR$(125);" ENTER A FILE NAME FOR THIS PROGRAM.":POKE 657,12:? "(Dn:filen
ame.ext)":POKE 752,0
3020 ? :? "FILE NAME: ";:INPUT F2$:POKE 752,1:? CHR$(125);:POKE 657,(25-LEN(F2$)
)/2:? "IS '";F2$;"' CORRECT?":?
3030 POKE 656,2:POKE 657,16:? "(Y OR N)":GET #1,KEY:IF KEY<>78 AND KEY<>89 THEN
GOSUB 2700:GOTO 3030
3040 IF KEY=78 THEN 3010
3050 CLOSE #2:IF DISK THEN 3080
3060 ? CHR$(125);"    INSERT THE DESIRED CASSETTE.":? :? "PRESS  RECORD & PL
AY  THEN  RETURN .";
3070 OPEN #2,8,0,"C:":FOR I=1 TO 65:? #2;CHR$(155):GOSUB 2:GOTO 3100
3080 ? CHR$(125);"    INSERT THE DESIRED DISKETTE.":? :? "        THEN PRESS  R
TURN .";:GET #1,KEY
3090 OPEN #2,8,0,"D:SCREEN.DAT":GOSUB 2
3100 POKE 77,0:? "         SCREEN DATA SAVED. ":GOSUB 2700:FOR I=1 TO 200
:NEXT I:? CHR$(125);:POKE 657,15
3110 ? " STAND BY ":? :? " WHILE THE PROGRAM IS REORGANIZED. ";:G
OSUB 2700:FOR I=1 TO 200:NEXT I
3120 GRAPHICS 0:? :? :IF DISK=0 THEN ? "ENTER ";CHR$(34);"C:":GOTO 3140
3130 ? "ENTER ";CHR$(34);"D:SCREEN.DAT"
3140 ? :? :FOR I=0 TO 8 STEP 2:? I:NEXT I:IF RAINBOW=0 THEN FOR I=1000 TO 1050 S
TEP 10:? I:NEXT I
3150 ? :? :? "CONT":FOR J=1 TO 100:NEXT J:POSITION 2,0:POKE 842,13:STOP


3160 POKE 842,12:BLINE=K:ELINE=904:S=20:GOSUB 3320
3170 GRAPHICS 0:? :? :J=50
3180 ? "100 GR.";7+SS;":POKE 708,";C1;":POKE 709,";C2;":POKE 710,";C3;":POKE 712
,";C4;":POKE 82,1:POKE 752,1":?
3190 IF RAINBOW THEN ? "40 DIM C$(32):TIME=10:GOSUB 1000:C$(15,15)=CHR$(22):Z=US
R(ADR(C$),TIME)"
3200 IF RANDOM THEN ? "40 POKE 77,254"
3210 IF FLASH THEN ? "40 FORI=1TO10:POKE708,";C4;":FORJ=1TO100:NEXTJ:POKE708,";C
1;":FORJ=1TO200:NEXTJ:NEXTI"
3220 IF SS=0 THEN FOR I=1 TO 152 STEP 38:? J;"POKE 656,";J/10-4;":?";CHR$(34);TW
$(I,I+37);CHR$(34);";":J=J+10:NEXT I
3230 IF F1$<>"" THEN ? "90 RUN ";CHR$(34);F1$:? :GOTO 3250
3240 ? "90 CLR:GOTO 40":?
3250 IF INVISIBLE THEN ? "110 POKE 559,0":? "140 POKE 559,34":?
3260 ? "CONT";:FOR J=1 TO 100:NEXT J:POSITION 2,0:POKE 842,13:STOP
3270 POKE 842,12:BLINE=2000:ELINE=3260:S=100:GOSUB 3320
3280 GRAPHICS 0:? :FOR I=3270 TO 3340 STEP 10:? :? I:NEXT I
3290 IF DISK=0 THEN ? :? "CSAVE":GOTO 3310
3300 ? "XIO 33,#2,0,0,";CHR$(34);"D:SCREEN.DAT":? :? :? "SAVE ";CHR$(34);F2$
3310 ? :? :? "POKE 842,12:GR.0";:POSITION 2,0:POKE 842,13:END
3320 FOR I=BLINE TO ELINE STEP S:GRAPHICS 0:? :? :FOR J=I TO I+S-1 STEP S/10:? J
:? :IF J<>ELINE THEN NEXT J
3330 ? "CONT":FOR J=1 TO 100:NEXT J:POSITION 2,0:POKE 842,13:STOP
3340 POKE 842,12:NEXT I:RETURN
```



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Joel Swank

The Vic SPY routine is a machine language program for the Vic-20 that monitors the contents of any three consecutive memory locations. It is executed every sixtieth of a second as part of the Vic IRQ (Interrupt Request) routine. It allows you to see the value of memory locations change as another program runs. This can be of value for debugging programs or just understanding how the Vic works.

SPY takes advantage of the Vic IRQ feature to display memory on the Vic screen while another program is running. Normally IRQ is used for updating the "jiffy" clock and scanning the keyboard. At power up the Vic KERNAL (control program) sets up one of the 6522 VIAs (Versatile Interface Adapters) to interrupt the 6502 microprocessor automatically every sixtieth of a second . When this interrupt occurs, the 6502 suspends execution of the program that is currently running and executes the interrupt handling routine in the KERNAL. The routine saves all of the registers in the 6502 and then executes the routine whose address is stored in the IRQ interrupt vector at memory location 788 ($314).

This vector normally contains the address of the KERNAL routine that updates the jiffy clock and scans the keyboard. But the user can change the contents of the vector to the addresses of another routine and have that routine executed automatically every sixtieth of a second. Only machine language programs, not Basic, can be executed this way. To allow all Vic functions to operate properly, this user IRQ routine should jump to the KERNAL IRQ routine when it has finished executing.

Listing 1 is a Basic program, called SPY Loader, that contains the SPY routine in data statements. It reads the data and POKES it into memory at the proper location. It also adds all data to get a checksum, which it checks against the checksum in the data. If the checksums match, SUCCESS is displayed, otherwise CHECKSUM ERROR is displayed.

This simple checksum does not guarantee that the data are correct, since it is possible to have cancelling errors, but it will catch most typing mistakes. It also changes the top of Basic memory so that Basic will not overwrite SPY with its variables.

After typing in this program, be sure to save a copy on tape before trying to use SPY. An error in a machine language program can cause the 6502 to "hang up". The only way to recover is to turn the Vic off and back on, which erases everything in memory.

Once you have a good copy of SPY Loader, it can be used to load SPY whenever you want to use it. After SPY Loader has been saved on tape, RUN it, and then erase it with a NEW command.

The SPY routine is initialized with a SYS 7168 command. SPY prompts for the address of the first of the three locations to be monitored with ADDRESS. The address must be entered as a one to four-digit hexadecimal number. A full line of digits may be entered, but only the last four are significant. If an invalid digit is entered, a question mark (?) will be displayed immediately following the invalid character, and SPY initialization will be terminated.

So that SPY will not interfere with the information on the screen, the screen is expanded by adding another line at the bottom. The first six bytes of this line are used to display three bytes of memory in hexadecimal. The display is updated every sixtieth of a second until the STOP routine is executed with a SYS 7299 command.

This command turns off SPY and restores the screen to normal. Pressing the STOP/RUN and RESTORE keys will also restore the IRQ vector and the screen to normal. SPY can be re-initialized with the SYS 7168 command. It can also be re-initialized without first executing the STOP routine.

Listing 2 is the assembly listing for SPY. This listing is in standard 6502 assembly language and was generated on an Aim-65 computer. SPY has three entry points. The first at label SPY is the initialization routine. First it enlarges the screen by altering a register in the Vic 6560 TV controller chip. It then clears the unused portion of the bottom

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line by storing the current screen color number in the color buffer locations for this line.

Next it prompts for and reads the address of the locations to be monitored. It then disables the IRQ interrupt in case an interrupt should occur during changing of the interrupt vector. It checks the current contents of the interrupt vector to see if the address of the SPY interrupt routine is already there. If it is not, the initialization routine saves the current contents of the vector and inserts that address of the SPY interrupt routine. Finally it enables IRQ interrupts and returns to Basic.

After the initialization routine has been executed, the routine SPYIRQ will be executed at each IRQ interrupt. SPYIRQ reads the contents of memory at the address entered at initialization, and displays three bytes in hexadecimal in the lower left corner of the screen. The three bytes of data are converted into six hexadecimal digits.

Then each digit is converted into its equivalent Vic screen code and stored in the proper location in the screen buffer. Finally, to allow normal Vic IRQ functions to work properly, SPYIRQ jumps to the routine whose address was originally in the IRQ vector.

The routine at label STOP is the routine that is executed with the SYS 7299 command. It disables interrupts and restores the original contents of the interrupt vector. It then enables interrupts, restores the screen to normal size, and returns to Basic. The SPY routine is then no longer active.

The Vic tape routines use the IRQ function, and SPY is not active during tape operations. SPY resumes normal operation after the tape operation has finished.

Once SPY is working properly, there are many interesting things that can be seen. First, use SPY to watch location $AO. This is the Vic jiffy clock. It is a three-byte number that is incremented every sixtieth of a second. You can clear it by typing TI$="000000". You will see that three bytes turn to zero and then start counting rapidly. Set TI$ to the current time (see the user's manual page ll4) to see what it looks like in sixtieths of a second since midnight.

Another interesting location is $C5. This is the byte in which the keyboard scan routine stores the keyboard matrix code for any key that is currently pressed. It contains $40 when no key is pressed. SPY location $C5 and watch it change as you press keys. Notice that this is not the ASCII value of the character on the key but an internal code for that key.

Now enter the following statement: FOR I=1 TO 10000:NEXT, and press some keys. You will see the keycode at $C5 change as before, but you will also see the following byte at $C6 increment by one each time you press a key. Location $C6 is the index for the keyboard input buffer in which the Vic saves keystrokes as you enter them. This buffer is located at $277-$280, and can hold up to 10 keystrokes while the Vic is occupied with other tasks. When the above statement ends, you will see that the keys you pressed appear on the screen and that location $C6 returns to zero.

SPY can be used to watch the I/O (Input/Output) ports. If you have a joystick connected, Spy address $9111. This is the port where all joystick functions except RIGHT are read. Move the joystick and press the fire button, and you will see location $9111 change. If you have a set of game paddles, you can spy addresses $9008 and $9009. This is where the 6560 stores the digitized value from the paddles. If you have a light pen, you can spy locations $9006 and $9007 in which the 6560 stores the position of the light pen on the screen.

There are many other interesting things that can be discovered with SPY. It can be used while testing either machine language or Basic programs. Because SPY uses some of the processing power of the 6502 each sixtieth of a second, programs will run about 4% slower while SPY is operating. ☐

Listing 1. Basic program to load SPY. Machine language program is loaded from DATA statements into memory. Checksum is used to verify correct data entry. SPY will run on a 5K or 8K Vic only.

```
100 REM MACHINE LANGUAGE LOADER FOR SPY
200 REM
300 POKE52,28:POKE56,28:POKE51,0:POKE55,0:CLR
400 CK=0
500 READ SA,EA
600 READ BY
700 CK=CK+BY
800 POKE SA,BY
900 SA=SA+1
1000 IF SA<=EA THEN 600
1100 READ BY
1200 IF BY=CK THEN PRINT "SUCCESS":END
1300 PRINT "CHECKSUM ERROR"
1400 DATA  7168, 7434
1500 DATA  169, 48, 141, 3, 144, 173, 15, 144, 74, 74
1600 DATA  74, 74, 41, 7, 162, 15, 157, 0, 148, 202
1700 DATA  16, 250, 162, 0, 189, 2, 29, 240, 6, 32
1800 DATA  210, 255, 232, 16, 245, 169, 0, 141, 13, 29
1900 DATA  141, 14, 29, 32, 207, 255, 201, 13, 240, 21
2000 DATA  201, 32, 240, 17, 32, 100, 28, 160, 3, 10
2100 DATA  46, 13, 29, 46, 14, 29, 136, 16, 246, 48
2200 DATA  228, 120, 173, 21, 3, 201, 28, 240, 19, 141
2300 DATA  12, 29, 173, 20, 3, 141, 11, 29, 169, 158
2400 DATA  141, 20, 3, 169, 28, 141, 21, 3, 88, 96
2500 DATA  201, 48, 48, 19, 201, 71, 16, 15, 201, 58
2600 DATA  144, 6, 201, 65, 144, 7, 105, 8, 10, 10
2700 DATA  10, 10, 96, 169, 63, 32, 210, 255, 104, 104
2800 DATA  96, 120, 173, 21, 3, 201, 28, 208, 12, 173
2900 DATA  11, 29, 141, 20, 3, 173, 12, 29, 141, 21
3000 DATA  3, 88, 169, 46, 141, 3, 144, 96, 162, 4
3100 DATA  181, 139, 72, 202, 16, 250, 160, 5, 173, 134
3200 DATA  2, 153, 250, 151, 136, 16, 250, 169, 31, 133
3300 DATA  140, 169, 250, 133, 139, 173, 13, 29, 133, 141
3400 DATA  173, 14, 29, 133, 142, 160, 0, 177, 141, 132
3500 DATA  143, 32, 224, 28, 164, 143, 200, 192, 3, 144
3600 DATA  242, 162, 0, 104, 149, 139, 232, 224, 5, 144
3700 DATA  248, 108, 11, 29, 72, 24, 74, 74, 74, 74
3800 DATA  32, 236, 28, 104, 41, 15, 201, 10, 144, 5
3900 DATA  56, 233, 9, 208, 2, 9, 48, 160, 0, 145
4000 DATA  139, 230, 139, 208, 2, 230, 140, 96, 65, 68
4100 DATA  68, 82, 69, 83, 83, 61, 0, 26386
READY.
```

Listing 2. Assembly listing of the SPY routine. Standard 6502 syntax is used.

```
0000          ;   VIC-20 SPY ROUTINE : DYNAMICALLY DISPLAYS THREE
0000          ;        BYTES OF MEMORY IN THE SIX UNUSED BYTES OF
0000          ;        THE VIC SCREEN BUFFER.

0000          ;   ZERO PAGE STORAGE

0000          S1     =$8B           ;TEMPORARY POINTERS
0000          ADDR   =$8D
0000          TEMP   =$8F

0000          ;   6560 TV CHIP

0000          TVCTL3 =$9003         ;SCREEN LENGTH REGISTER
0000          TVCTLF =$900F         ;SCREEN COLOR REGISTER

0000          ;   VIC RAM LOCATIONS

0000          CURCOL =$286          ;CURRENT COLOR
0000          SCRBUF =$288          ;SCREEN BUFFER PAGE
```

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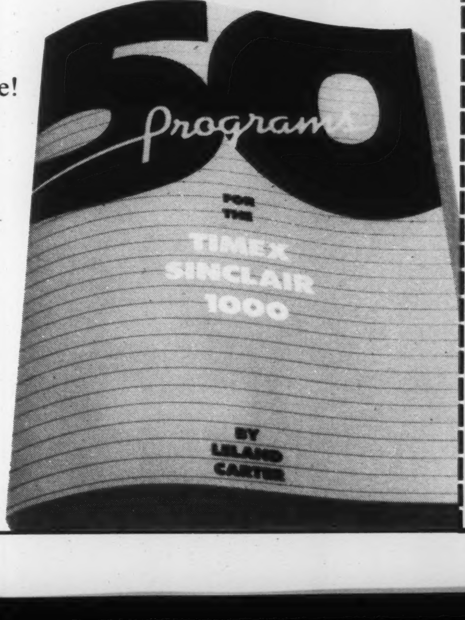

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```
0000              IRQVEC =$314             ;IRQ VECTOR

0000              ;    SUBROUTINES

0000              CHROUT =$FFD2            ;SEND CHARACTER TO SCREEN
0000              CHRIN  =$FFCF            ;INPUT A CHARACTER

0000              ;    EQUATES

0000              SPYLEN =3                ;BYTES TO SPY
0000              BLANKP =$20              ;BLANK
0000              CR     =13               ;CARRIAGE RETURN

0000                     *=$1C00

1C00              ;    ENTRY TO START THE SPY ROUTINE - SYS 7168

1C00   A9 30      SPY    LDA #$30          ;ENLARGE SCREEN BY 1 LINE
1C02   8D 03 90          STA TVCTL3
1C05   AD 0F 90          LDA TVCTLF        ;SET LAST 16 BYTES OF LAST
1C08   4A                LSR A             ;TO SCREEN COLOR
1C09   4A                LSR A             ;TO MAKE THEM BLANK
1C0A   4A                LSR A
1C0B   4A                LSR A
1C0C   29 07             AND #$7
1C0E   A2 0F             LDX #15
1C10   9D 00 94   WHITEC STA $9400,X       ;STORE A BYTE
1C13   CA                DEX               ;NEXT
1C14   10 FA             BPL WHITEC

1C16              ;    GET ADDRESS TO SPY

1C16   A2 00      GETADD LDX #0            ;FIRST PROMPT USER
1C18   BD 02 1D   MSGLUP LDA MSG,X         ;GET A BYTE
1C1B   F0 06             BEQ INPUT         ;QUIT IF ZERO
1C1D   20 D2 FF          JSR CHROUT        ;SEND A CHARACTER
1C20   E8                INX               ;NEXT
1C21   10 F5             BPL MSGLUP

1C23   A9 00      INPUT  LDA #0            ;CLEAR REPLY AREA
1C25   8D 0D 1D          STA SPYADD
1C28   8D 0E 1D          STA SPYADD+1
1C2B   20 CF FF   ADDLUP JSR CHRIN         ;GET A CHARACTER
1C2E   C9 0D             CMP #CR           ;CR?
1C30   F0 15             BEQ ADDDUN        ;YES, DONE
1C32   C9 20             CMP #' '          ;BLANK?
1C34   F0 11             BEQ ADDDUN        ;YES DONE
1C36   20 64 1C          JSR PAKHEX        ;PACK INTO HEX NYBBLE
1C39   A0 03             LDY #3
1C3B   0A         SHIFT  ASL A             ;AND SHIFT INTO REPLY AREA
1C3C   2E 0D 1D          ROL SPYADD
1C3F   2E 0E 1D          ROL SPYADD+1
1C42   88                DEY               ;ALL 4 BITS
1C43   10 F6             BPL SHIFT
1C45   30 E4             BMI ADDLUP

1C47   78         ADDDUN SEI               ;DISABLE INTERRUPTS
1C48   AD 15 03          LDA IRQVEC+1      ;GET IRQ VECTOR HI
1C4B   C9 1C             CMP #>SPYIRQ      ;IS IT OURS?
1C4D   F0 13             BEQ SKIPUP        ;YES , SKIP VECTOR UPDATE
1C4F   8D 0C 1D          STA SPYSA+1       ;NO, SAVE CURRENT VECTOR
1C52   AD 14 03          LDA IRQVEC
1C55   8D 0B 1D          STA SPYSA
1C58   A9 9E             LDA #<SPYIRQ      ;SET VECTOR TO WATCH ROUTINE
1C5A   8D 14 03          STA IRQVEC
1C5D   A9 1C             LDA #>SPYIRQ
1C5F   8D 15 03          STA IRQVEC+1
1C62   58         SKIPUP CLI               ;ALLOW INTERRUPTS
1C63   60                RTS               ;RETURN TO BASIC


1C64              ;    PAKHEX : PACK ASCII HEX INTO HEX NYBLE

1C64   C9 30      PAKHEX CMP #$30          ;LESS THAN '0'
1C66   30 13             BMI ERRRET        ;YES, ERROR
1C68   C9 47             CMP #$47          ;GREATER THAN 'F'
1C6A   10 0F             BPL ERRRET        ;YES, ERROR
1C6C   C9 3A             CMP #$3A          ;NUMERIC?
1C6E   90 06             BCC NOADD         ;YES
1C70   C9 41             CMP #$41          ;ALPHABETIC?
1C72   90 07             BCC ERRRET        ;NO, ERROR
1C74   69 08             ADC #8            ;ADD 8 PLUS CARRY
1C76   0A         NOADD  ASL A             ;SHIFT TO HI NYBBLE
1C77   0A                ASL A
1C78   0A                ASL A
1C79   0A                ASL A
1C7A   60                RTS

1C7B   A9 3F      ERRRET LDA #'?'          ;SEND ERROR MSG
1C7D   20 D2 FF          JSR CHROUT
1C80   68                PLA               ;RESTORE STACK
1C81   68                PLA
1C82   60                RTS


1C83              ;    ENTRY TO STOP THE SPY ROUTINE - SYS 7299

1C83   78         STOP   SEI               ;DISABLE INTERRUPTS
1C84   AD 15 03          LDA IRQVEC+1      ;GET VECTOR HI BYTE
1C87   C9 1C             CMP #>SPYIRQ      ;IS SPY ACTIVE?
1C89   D0 0C             BNE NOREST        ;NO, DON'T RESTORE
1C8B   AD 0B 1D          LDA SPYSA         ;YES, RESTORE ORIGINAL VECTOR
1C8E   8D 14 03          STA IRQVEC
1C91   AD 0C 1D          LDA SPYSA+1
1C94   8D 15 03          STA IRQVEC+1
1C97   58         NOREST CLI
1C98   A9 2E             LDA #$2E          ;RESTORE SCREEN SIZE
1C9A   8D 03 90          STA TVCTL3
1C9D   60                RTS

1C9E              ;       SPYIRQ : SPY INTERRUPT ROUTINE

1C9E              ;    *** THIS CODE IS EXECUTED IN THE IRQ INTERRUPT
1C9E              ;           ROUTINE - DO NOT DALLY  ***

1C9E   A2 04      SPYIRQ LDX #4            ;SAVE POINTERS ON STACK
1CA0   B5 8B      WSAVL  LDA S1,X
1CA2   48                PHA
1CA3   CA                DEX
1CA4   10 FA             BPL WSAVL
```

```
0113  1CA6  A0 05                LDY #SPYLEN+SPYLEN-1
0114  1CA8  AD 86 02             LDA CURCOL         ;STORE CURRENT COLOR
0115  1CAB  99 FA 97    COLOR1   STA $97FA,Y        ;IN ALL LOCATIONS
0116  1CAE  88                   DEY
0117  1CAF  10 FA                BPL COLOR1
0118  1CB1  A9 1F                LDA #$1F           ;USE $1FFA AS POINTER TO
0119  1CB3  85 8C                STA S1+1           ;SCREEN BUFFER LOCATION TO
0120  1CB5  A9 FA                LDA #$FA           ;DISPLAY MEMORY
0121  1CB7  85 8B                STA S1
0122  1CB9  AD 0D 1D             LDA SPYADD         ;MOVE ADDRESS OF LOCATION
0123  1CBC  85 8D                STA ADDR           ;TO WATCH TO ZERO PAGE
0124  1CBE  AD 0E 1D             LDA SPYADD+1
0125  1CC1  85 8E                STA ADDR+1
0126  1CC3  A0 00                LDY #0
0127  1CC5  B1 8D       SPYLUP   LDA (ADDR),Y       ;DISPLAY ALL BYTES
0128  1CC7  84 8F                STY TEMP           ;SAVE INDEX
0129  1CC9  20 E0 1C             JSR HEXPOK         ;PUT ON SCREEN
0130  1CCC  A4 8F                LDY TEMP           ;RESTORE INDEX
0131  1CCE  C8                   INY                ;NEXT BYTE
0132  1CCF  C0 03                CPY #SPYLEN        ;ALL DONE?
0133  1CD1  90 F2                BCC SPYLUP
0134  1CD3  A2 00                LDX #0             ;RESTORE POINTERS FROM STACK
0135  1CD5  68          WRESL    PLA
0136  1CD6  95 8B                STA S1,X
0137  1CD8  E8                   INX

0138  1CD9  E0 05                CPX #5
0139  1CDB  90 F8                BCC WRESL
0140  1CDD  6C 0B 1D             JMP (SPYSA)        ;NOW DO NORMAL IRQ

0141  1CE0              ;   HEXPOK : POKE ACCUM INTO SCREEN BUFFER AT (S1)
0142  1CE0              ;               IN HEX

0143  1CE0  48          HEXPOK   PHA                ;SAVE A COPY
0144  1CE1  18                   CLC
0145  1CE2  4A                   LSR A
0146  1CE3  4A                   LSR A              ;GET HI NYBBLE
0147  1CE4  4A                   LSR A
0148  1CE5  4A                   LSR A
0149  1CE6  20 EC 1C             JSR HEXP1          ;SEND TO SCREEN
0150  1CE9  68                   PLA                ;RESTORE BYTE
0151  1CEA  29 0F                AND #$F            ;GET LOW NYBBLE

0152  1CEC  C9 0A       HEXP1    CMP #$A            ;ALPHA?
0153  1CEE  90 05                BCC NUMBER         ;NOPE
0154  1CF0  38                   SEC
0155  1CF1  E9 09                SBC #9             ;YES, SUBTRACT 9
0156  1CF3  D0 02                BNE HEXSKP         ;TO GET POKE CODE
0157  1CF5  09 30       NUMBER   ORA #$30           ;ADD $30 TO GET POKE CODE
0158  1CF7  A0 00       HEXSKP   LDY #0             ;CLEAR INDEX
0159  1CF9  91 8B                STA (S1),Y         ;STORE POKE CODE ON SCREEN
0160  1CFB  E6 8B                INC S1             ;BUMP S1
0161  1CFD  D0 02                BNE NOCY
0162  1CFF  E6 8C                INC S1+1
0163  1D01  60          NOCY     RTS

0164  1D02              ;   PROMPT MESSAGE

0165  1D02  41 44       MSG      .BYT 'ADDRESS=',0
0166  1D04  00


0167  1D05              ; DATA AREAS

0168  1D0B              SPYSA   *=*+2               ;SAVE IRQ VECTOR
0169  1D0D              SPYADD  *=*+2               ;ADDRESS TO SPY

0170  1D0F              LASTBY .END
0171  1D0F               ERRORS= 0000

SYMBOL DEFINED REFERENCES

A        0000    0148 0147 0146 0145 0085 0084 0083 0082 0053 0030 0029 0028 0027
ADDDUN   0059    0050 0048
ADDLUP   0046    0058
ADDR     0006    0127 0125 0123
BLANKP   0020
CHRIN    0017    0046
CHROUT   0016    0088 0040
COLOR1   0115    0117
CR       0021    0047
CURCOL   0012    0114
ERRRET   0087    0080 0076 0074
GETADD   0037
HEXP1    0152    0149
HEXPOK   0143    0129
HEXSKP   0158    0156
INPUT    0043    0039
IRQVEC   0014    0100 0098 0094 0069 0067 0064 0060
LASTBY   0170
MSG      0165    0038
MSGLUP   0038    0042
NOADD    0082    0078
NOCY     0163    0161
NOREST   0101    0096
NUMBER   0157    0153
PAKHEX   0073    0051
S1       0005    0162 0160 0159 0136 0121 0119 0109
SCRBUF   0013
SHIFT    0053    0057
SKIPUP   0070    0062
SPY      0024
SPYADD   0169    0124 0122 0055 0054 0045 0044
SPYIRQ   0108    0095 0068 0066 0061
SPYLEN   0019    0132 0113 0113
SPYLUP   0127    0133
SPYSA    0168    0140 0099 0097 0065 0063
STOP     0093




TEMP     0007    0130 0128
TVCTL3   0009    0103 0025
TVCTLF   0010    0026
WHITEC   0033    0035
WRESL    0135    0139
WSAVL    0109    0112
X        0000    0136 0109 0038 0033
Y        0000    0159 0127 0115
```

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Susan Glinert-Cole

Last month I recall bemoaning the fact that my predecessor's desk, as opposed to my own, was probably overloaded with all manner of interesting items. In what must have been a fit of malicious glee, Will indulged in some thorough housecleaning. The end result of this arrived on my doorstep this week. The UPS deliveryman's back is improving every day, and he will be out of the hospital next week. The dining room has once again lost its epicurean elegance and has taken on an appearance usually associated with second-hand furniture stores.

There is an unexpected benefit to this situation; a typical social conversation now goes something like this: "We'd love to have you over for dinner next Friday; I hope you don't mind eating on the floor . . ." If the other party is on the ball, the response is "Um, well, why don't you guys come over here instead?"

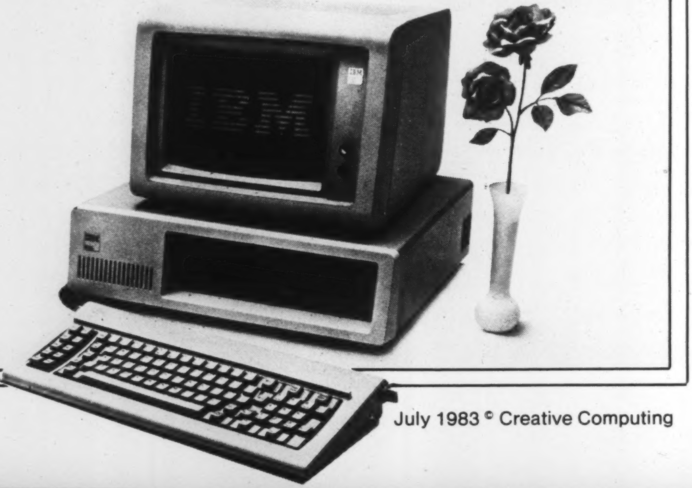
So far we haven't had to do any baseboard entertaining, in fact, we haven't had to do any entertaining at all. Half of our friends commiserate with us in our loss of the dining room and the other half is afraid to visit lest they fall into a box of arcade games. I have assured everyone that we will honor our social backorders just as soon as I can get around to reviewing all that stuff. I think 1995 will be a real busy year for dinner parties.

In addition to the entire contents of Will's garage, a few quality utilities also arrived, and are well worth reviewing in detail; I will say a few intelligent words about a little-known aspect of the p-System, and wind up with a convenient method of labelling function keys. Before I get to these items, there is first . . .

The Big News of the Month

In case you have been worrying that IBM hasn't been keeping up with planned obsolescence, take heart. Your PC has become last year's good news, and DOS 1.1 is now another item for the yearly yard sale. (Our yard sale this year will unquestionably be the most unique in the history of South Windham, Maine.)

IBM has announced its newest version of the Personal Computer, the XT. The XT is, at heart, a PC, but sports such



Susan Glinert-Cole, RFD #2, Box 389A, South Windham, ME 04082. Correspondence can only be acknowledged when a stamped, self-addressed envelope has been provided.

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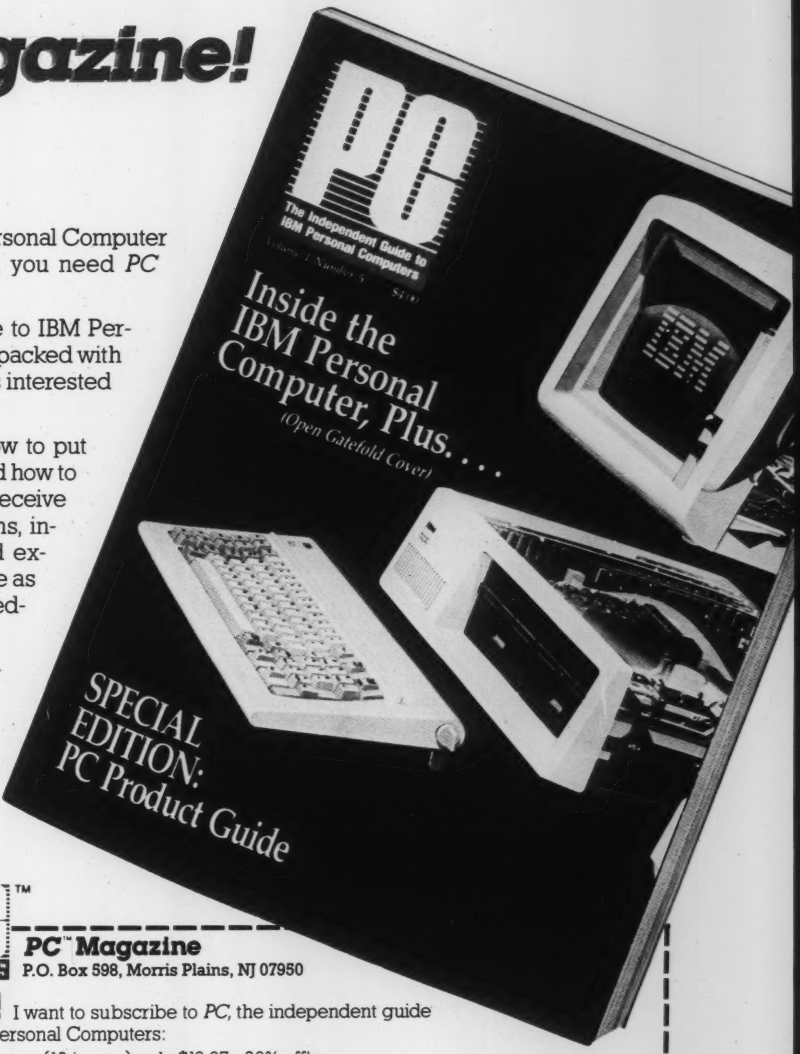
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IBM Images, continued...

built-in features as a 10Mb hard disk (referred to as a fixed disk), 128K of memory, one dual-sided floppy disk drive, and an asynchronous communications adapter. The system unit housing of the XT has the same exterior appearance as the PC, but inside there are eight expansion slots, three of which come occupied by the floppy disk, hard disk, and asynch adapters. The cost of this wonderful system is (sigh) $4995.

Before you start gnashing your teeth and wishing you had waited just two weeks longer to purchase your computer, there were some more announcements at the press conference which will remove at least some of the sting from your semi-obsolesced unit. First, expansion units are now available for both the PC and the XT. The expansion unit for both computers comes with a 10Mb hard disk and eight expansion slots. Of these eight, six will accept full size option cards and two will take only smaller cards. Two of the six full size slots come already equipped with the hard disk adapter and the card which interfaces the system unit with the expansion unit. (Don't forget that one slot in the main system unit also needs an interface card.)

This leaves four full size and two less-than-full-size slots for you to fill up with an interesting assortment of option cards. The smaller slots will accommodate the IBM printer, asynchronous communications, game or prototype boards. The expansion units may not contain memory cards, main display adapters or diskette adapters, since the expansion unit accepts two hard disk drives only; any floppy disk drives you might have must remain resident in your system unit.

If you decide to upgrade your PC, there are a couple of ways to begin. The least expensive route is to buy the IBM hard disk and install it in your system unit. This will cost $1695 for the drive and $695 for the drive adapter, for a grand total of $2390. If you are feeling particularly expansive, both in the wallet and in your peripheral philosophy, an additional $1000 will get you the expansion unit for the PC. This includes the hard disk and adapter and the attachment cards necessary to connect the system and expansion units. If you already have a hard disk in the main unit, you will have to move it to the expansion unit.

IBM points out that the fixed drive is customer installable, which indicates that the set-up is simple enough for the average user to do with a minimum of effort. The technical data for the fixed drive are as follows:

10,240,000 bytes of storage
512 bytes per sector
17 sectors per track
306 tracks per surface, 4 surfaces
3600 RPM
5 megabit per second transfer rate
DC power only (+12V, +5V)

And Then . . .

IBM also announced a color display monitor which I have seen at Computerland; it is really beautiful. The price is amazingly low for an RGB monitor; $680 will buy you a 12" screen with 16 foreground and eight background colors for your aesthetic delight. It will display forty or eighty characters per line, 25 lines per screen and has brightness and contrast controls on the front panel. In size, it is slightly larger than the monochrome display, but this is noticeable only if the two units are compared side by side.

IBM has now begun international distribution of the PC and the XT. The happy byproduct of this decision is the availability of international versions of the keyboard. You may now type away in French, German, Italian, Spanish, or British. This last keyboard obviously must include the pound sign; my imagination leads me to think that other enhancements might include a T key which, in addition to blinking at 4:00, may also be used in conjunction with the Control key to allow the disk drives to accept single or dual sided 5¼" crumpets.

Price reductions were announced for several of IBM PC products; the price for a single sided disk drive plummetted to $289. By the time this column sees print, the prices may have been changed again, so see your distributor for the latest price list.

Quite a few new or upgraded software packages were released this month. I am embarrassed to admit that I haven't yet seen any of them, including the new DOS 2.0, which looks like an outstanding superset of DOS 1.1.

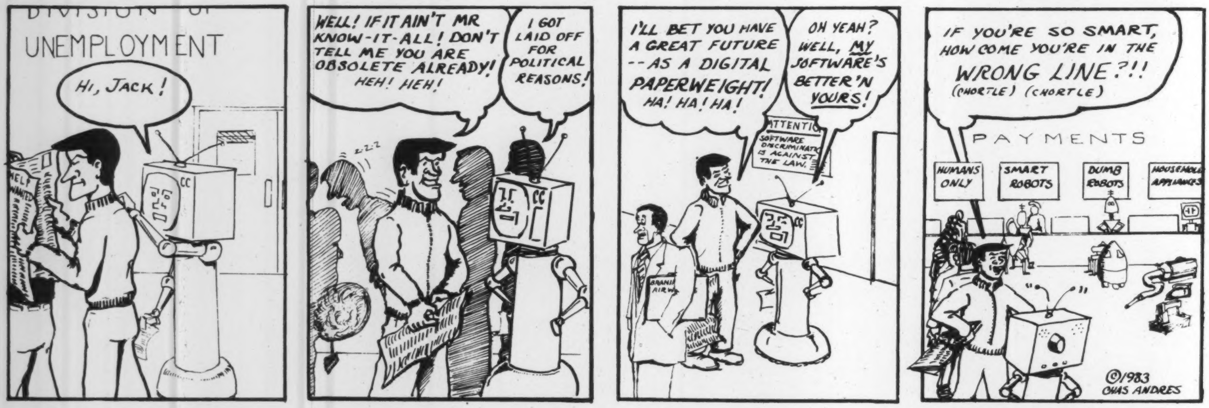
Programs running under standard DOS 1.1 will be upwardly compatible with 2.0, but software which uses absolute address calls will not be transportable across operating systems. DOS 2.0 includes many of the features already available in the UCSD p-System, such as "piping" (using the output of one program as the input to another), print spooling, and the ability to direct file input and output at will (for example, directing keyboard input to the printer or to a disk file). The new Advanced Basic which comes with DOS 2.0 has enhancements for the graphics, music, and function keys. The next Images column will look closely at the new DOS and Basic.

The UCSD p-System in Living Color

Despite all the boxes of canned soft-

Bit Pit

Chas Andres


DIVISION OF
UNEMPLOYMENT
HI, JACK!
HELP WANTED
CC
WELL! IF IT AIN'T MR KNOW-IT-ALL! DON'T TELL ME YOU ARE OBSOLETE ALREADY! HEH! HEH!
I GOT LAID OFF FOR POLITICAL REASONS!
Z-Z-Z
I'LL BET YOU HAVE A GREAT FUTURE --AS A DIGITAL PAPERWEIGHT! HA! HA! HA!
OH YEAH? WELL, MY SOFTWARE'S BETTER'N YOURS!
ATTENTIO
SOFTWARE DISCRIMINATIO IS AGAINST THE LAW.
BRANIF AIRW
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PAYMENTS
HUMANS ONLY
SMART ROBOTS
DUMB ROBOTS
HOUSEHOLD APPLIANCES
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ware that arrived this week, my curiosity is more piqued by operating systems, languages, and utilities which permit exploration of the underlying computer physiology. In particular, one of my more furtive indulgences is randomly banging keys in the hopes of uncovering a hitherto unknown feature of the software in question. Usually, the result of such techno-torture is an advanced case of computer hysterics, generally manifested by a lockup, disappearance of the operating system, or (rarely) a series of plaintive wails issuing from the speaker. Well, it finally happened; I stumbled upon a feature of the p-System that the folks at NCI didn't realize was available, although it is obliquely documented in the manual.

It seems that, with the proper keystrokes, it is possible to write a file in all the colors and attributes available in the BIOS and convert a visually tiresome program or text file into a dazzling alphabetic rainbow. The file can be handled almost exactly like the plain vanilla version, although there are a few important caveats which are described below. This technique is not just an idle conceit, I have put it to use in two ways, and I am sure there are other applications to discover.

I tend to write long, lyrical epistles in Pascal and, when paging quickly through a program I sometimes have a hard time locating specific procedure headings. Not any more. Procedure headings are now all in red, or blink, or have some other interesting attribute.

The second application is for inserting variable trace statements. These lines have an obnoxious habit of being difficult to locate when they are no longer needed, but if inserted in a contrasting color they are immediately apparent and a snap to delete. While a file sometimes looks like I threw a bucket of paint at it, it is much easier to locate specific areas for subtle alteration (read debugging). Monochrome display owners can, of course, use blink, highlight, and underline instead of technicolor.

The procedure is very simple. Control-\ is the prefix for the foreground colors, Control-6 is the prefix for the background colors and Control-X is the prefix for the border. For the decimal digits 1-9, use the top row of number keys; for numbers higher than 9, use ALT plus the desired number. To try it out, go into the editor and begin entering text. Press Control-\ and then 4. The text is now dark red. Control-\, ALT, 14 makes the foreground yellow. Control-6, 1 produces a blue background and Control-X, 4 gives a red border.

To make the characters blink, add 7 to the desired blinking color, and type Control-6 plus the number (again, use the top row of numbers for decimal digits and ALT plus the number for values greater than 9). There are a few precautions to observe when using this technique. First, if you are typing in a program, you must put these control characters inside comment brackets. The compiler will give an illegal character in text error if you do not.

Second, do not use the ALT key to enter numbers less than 10. This causes the editor in particular, and the operating system in general to do unpredictable and unpleasant things.

Thirdly, these codes are not invisible to the printer. If you run a colored file to the printer, the text must be filtered through some kind of formatting program to avoid any problems that the unusual signals might cause.

The Norton Utilities

In a word: wonderful. There are 14 programs in this package, all of which are useful, and most of which are outstanding examples of what a truly talented and imaginative program designer can do with a versatile system like the IBM PC. The set sells for $80.

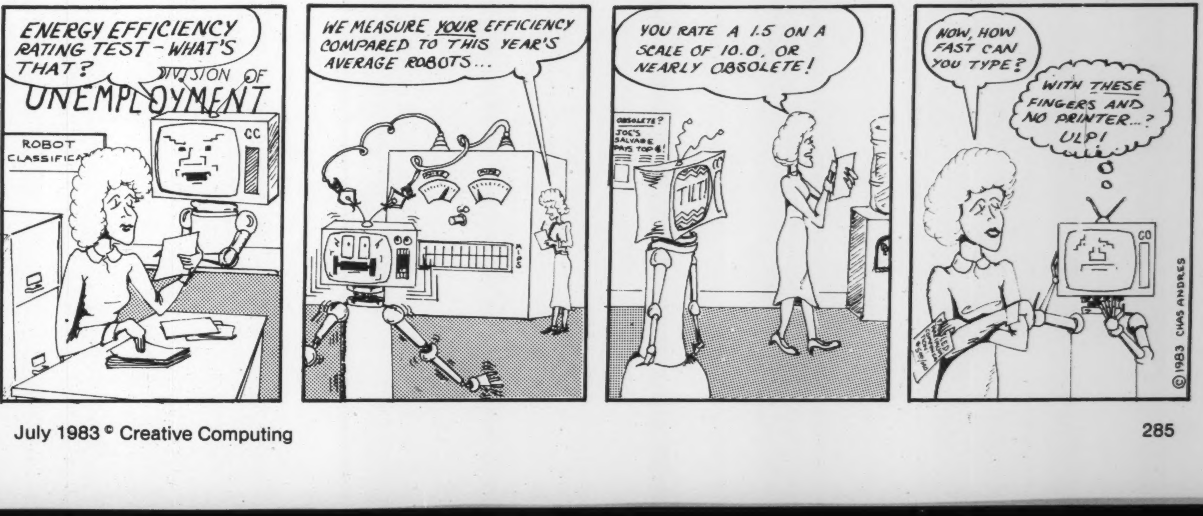
The programs function as external DOS commands and are accessed exactly like other external files such as CHKDSK. Some of these utilities provide the operating system with functions usually only available from Basic; other programs allow exploration and manipulation of disk files on an intimate level. The more extensive utilities are menu-driven and are so coherent and well done that they are, in most cases, completely self-explanatory.

All the menus make excellent use of the function and cursor keys and the keys are assigned consistently, when possible, across all the menus. The documentation is very well written and fits neatly into the DOS binder. The programs, together with the documentation, provide a thorough tutorial on disk organization and give useful insights into the operating system itself.

Seven of the programs were designed to be incorporated into batch files. Beep produces a loud noise and would be useful in rousing the operator from a stupor. Clear clears the screen, Reverse changes the display to reverse video, Timemark will display current or elapsed time and could be used to show the operator just how long he was dozing before Beep went off. Scratr sets the screen to any desired display mode, Bathide hides or unhides files during batch processing and Print is a simple utility designed to output a neat hard copy of an ASCII file.

Two of the programs allow quick and convenient rearrangement of files and utilities. Filesort sorts directories by four primary keys (file name, file extension, date and time of creation, and file size). Diskopt rearranges directory entries into an order which optimizes access time. It is necessary to follow this program with the Copy utility to put the files onto a disk in the same order as the directory.

Filehide is the interactive version of Bathide. A file may be designated as hid-


ENERGY EFFICIENCY RATING TEST - WHAT'S THAT?
DIVISION OF UNEMPLOYMENT
ROBOT CLASSIFICA
CC
WE MEASURE YOUR EFFICIENCY COMPARED TO THIS YEAR'S AVERAGE ROBOTS...
YOU RATE A 1.5 ON A SCALE OF 10.0, OR NEARLY OBSOLETE!
OBSOLETE? JOE'S SALVAGE PAYS TOP $!
TILT!
NOW, HOW FAST CAN YOU TYPE?
WITH THESE FINGERS AND NO PRINTER...? ULP!
CO
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den, normal, system, or combinations of these, and the type of file is coded into an attribute byte associated with the file in the directory. Filehide allows the user access to this attribute byte and presents all the files with their attributes as listed in the disk directory. The function keys are used to switch files from hidden to normal, from normal to system, and so forth, and another function key will write the information to disk. This program would be useful in unhiding files which have been received this way, as well as protecting your own from accidental erasure or unwanted meddling by the cat.

Filefix and Unerase belong to the same class of objects as fire extinguishers: essential when needed, but the hope is that they will sit around forever providing tract housing for the spider community. Filefix will peruse a disk for damaged areas and try to recover those regions which have escaped the effects of the cup of coffee, pizza crumbs or what have you. Unerase is a sophisticated utility which requires some practice to use and good understanding of the finer points of disk organization (which can be obtained from a couple of hours of using this set of utilities).

The documentation section for this program is not as clear as the rest; in a panic situation it would be a disaster. I am reminded in a vague way of the instructions that came with our fire extinguisher . . .they appeared to make sense until the moment arrived when we needed to put out the toaster oven in a hurry, and then somehow neither of us could figure out how to make the extinguisher do the appropriate thing.

Fortunately, a file which has been accidently erased is not going to degenerate while sitting around the disk (unlike the situation on our kitchen counter), so ample time can be given to reading and rereading the directions and doing a few practice runs. The instructions which come with the program run on for eight pages. What is really needed is a step-by-step summary, with the theory and warnings omitted, placed somewhere for easy access in a time of trial.

The general concept relies on the fact that, when a file is erased, only two things really happen. First, the space which has been allotted to the file by the disk management utilities in the operating system is designated as free to be written over and second, the first letter of the file name is changed to indicate that this directory entry is now available for use by another file. This means that, if you have erased a file by accident and have done no writing to disk, Unerase will be able to recover the file for you. If you have done some disk manipulation since the erasure, Unerase may be able to save at least some of the parts of the file which have not yet been overwritten by other data.

The advanced programmer who is familiar with hexadecimal will be able to do intricate and specialized customization of files using the program Secmod. This utility enables the knowledgeable user to browse through a file sector by sector, modify code, and write the revised data back to the file. Each sector is displayed simultaneously in hex and ASCII, so programs which contain ASCII code can be modified by those who are not familiar with hex. The cursor keys are used to move from nibble to nibble or sector to sector, and the tab key will switch the cursor from the hex side of the display to the ASCII side.

Any changes that you make are highlighted until the information is written to disk. I used this program to change the start-up messages. It is possible (and also extremely advisable) to make a hard copy of the sector under scrutiny using the PrtSc key; any unprintable characters are stripped from the hard copy output. Since the changes are no longer highly visible after becoming permanent, it is difficult to locate exactly where the modifications began and ended unless a hard copy is kept.

One further suggestion: this may seem obvious, but do make a copy of the program to be modified and make the changes on that before putting them into the library copy. It is easy to get carried away with this utility.

My favorite program in the set is without question Disklook. This utility is an educational and graphic masterpiece. It provides complete information for every file on a disk, including the name, size, attribute and creation date, plus a map which displays the sectors of the disk on which the file is located. One function key allows you to view a map of the entire disk, showing you what is occupying every sector, and giving textual information concerning the amount of space allocated to different types of files or bad sectors. The graphic presentation of these maps is absolutely outstanding.

You can also display the file sector by sector, using the function keys to stroll around the file at will. Disklook will also sort the directory ten different ways (five each for normal and erased files), which makes it very easy to locate what you are looking for. At first, it didn't appear that this program was going to be really useful for much more than a guided tour, but I have since used it to organize files, check the location of bad tracks, ascertain the fragmentation of various programs, and, in conjunction with Secmod, modify selected sectors of the disk.

Peeks and Pokes

The actual name of this utility package is (alas) *Peaks 'n Pokes,* but I couldn't bear to use that as a header. It took me a little while to reconcile the name with my lexicographical prejudices. However, paging quickly past the title I found some worthwhile

SKILLS: NUMBER CRUNCHING AND MIXING DRINKS! HMMM...
DISCRIMINAT ON THE BASIS SOFTWARE GAINST LAW!
MS. D. MEANOR
YOUR CAREER PATH IS NOT WELL DEFINED, MR. JAKE!
BUT I LIKE BARTENDING!
MS. D. MEANOR
NOT IN THIS ECONOMY- HOW ARE YOU AT CALCULATING INSURANCE RATES?
ROBOTS 5 YR. OLD & OLDER
FIELD SERVICE INSURANCE
YOU CAN'T BE TURNED DOWN!
$500/MO
I'LL SLEEP UNDER THE EXPRESSWAY FIRST!
WAIT! I'VE ALSO GOT AN OPENING FOR A POOL SWEEP!
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information and a pleasant package of over 50 programs which permit easy access to individual areas of the IBM memory.

This package might be better renamed "Bit Twiddling Made Easy." Some of the programs perform the same functions as a few of the *Norton Utilities:* Beep, CLS, and Reverse even share the same names. *PnP* includes a few additional batch-oriented functions of this kind: Mono switches from a color to a monochrome adapter, Color does the opposite, Page prints a Top of Form character to the printer and Wait is an even more effective variation of Beep—it honks every five seconds until someone presses a key, turns off the computer, or takes an axe to the thing.

The instruction manual is a little skimpy, but includes a good introduction to the PC Basic commands PEEK, POKE, BLOAD, BSAVE, INP and OUT. Individual sections describe which byte(s) of memory contain system information, precisely how these data are represented in the individual bits, and how to change each bit from inside a Basic program. Most of the programs in this set are subroutines which will read information from memory about the system status and write certain selected data back to the correct area. Each program deals with a specific component of memory.

The programs may be accessed for demonstration purposes from a main menu program. For example, Keyread will read the bytes associated with the keyboard which are at absolute memory locations 1047 and 1048. It then displays the current keyboard status. Keyset sets and clears selected bits in the keyboard status bytes, and Keyplug allows you to enter data into the keyboard buffer. The status of all I/O devices (disks, printers, displays, RS-232 adapters) may be similarly monitored and altered.

The real usefulness of these programs lies in the fact that you are permitted to merge them into your own Basic and Pascal programs, which adds a tremendous amount of power to these languages in a very convenient fashion. Instructions which describe how to locate and manipulate areas of memory not specifically covered in the manual are included. The curious and inventive will find this package very enjoyable. It is certainly reasonably priced; $30 buys the lot.

Where Did I Put That Template?

The function keys on the PC are wondrous items. Unfortunately, they do not gracefully lend themselves to easy identification. One word processing package I use comes with a little overlay for the keys which has the tiresome habit of flipping onto the floor or sliding under the system unit. I also realize that inevitably, it will get lost and render the word processor inconvenient (there is a great deal of information on that little overlay). I found another way to label the keys a while back which works well if there is a certain reassignment set that you use often.

Hewlett-Packard sells, for the delectation of 41-C calculator owners, sheets of tiny, adhesive labels which match, remarkably enough, the grey color of the PC function keys. They are somewhat expensive, since half the labels are preprinted with calculator functions, and the kit includes overlays for the 41-C keyboard. You end up with 350 blank labels, each costing around two cents apiece or twenty cents for a set of informative function keys. (If you are reassigning the cursor keys, add four to everything).

A very fine pen is required to letter these labels and they are best positioned on the front of the keys with a pair of tweezers. The don't stick well to the tops of the keys for some reason, but mine have clung grimly to the fronts for well over a year. They can be removed and/or replaced with other labels or used on a custom template which has been cut out of durable plastic with a mat knife.

I have conceived countless uses for the preprinted labels. One was the upgrading of our refrigerator to a high-tech machine by the simple addition of little LN 1 + X's and X > 0 ?'s all over the front. Another use, which has not been field tested yet, is to stick them on homemade jelly jars, fill the jars with the appropriate colloid and give them away. Any room in your house can be painstakingly redecorated in a mathematical fashion if you are tired of the same old wallpaper, and they would make interesting, if minute, Christmas tree decorations. □

Firms mentioned in this column

The Norton Utilities
1716 Main St.
Venice, CA 90291
$80 for the set

Data Base Decisions
14 Bonnie Lane
Atlanta, GA 30328

Hewlett-Packard
1000 N.E. Circle Blvd.
Corvallis, OR 97330

Network Consulting Inc.
Suite 110-3700 Gilmore Way
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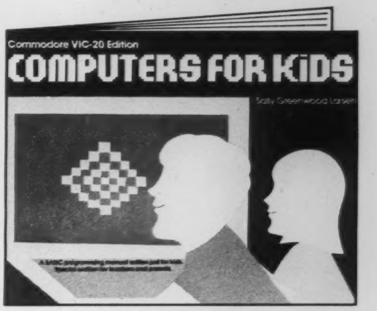

By Sally Greenwood Larsen

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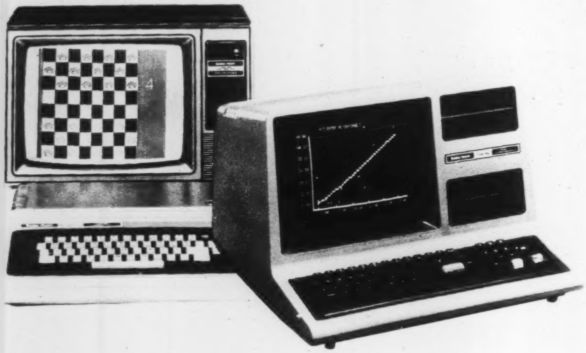

rings...trs-80 strings...trs-8

Stephen B. Gray

Previewing reel fifty-three of the epic film, "The Machine From Fort Worth," we see it includes scenes featuring the new PC-4 Pocket Computer, the *SuperScripsit* word processing program, a newsletter for lawyers who use the TRS-80, and a short music program for the Color Computer.

PC-4 Pocket Computer

Earlier this year Radio Shack introduced its lowest-cost Pocket Computer, the PC-4, at $69.95, to replace the PC-1.

The PC-4 (Figure 1), which seems to be a relabeled Casio PB-100, thus replaces a relabeled Sharp PC-1211. It has the same QWERTY keyboard plus numeric keypad, and is $6^1/_2$" long, only a trifle shorter than the PC-1, but is about half as thick, only $^3/_8$".

The PC-4 displays 12 LCD characters at a time, half as many as the PC-1. Math functions on the PC-4 include trig and inverse trig, radians or gradians, log, exponent, square root, angular conversions, and absolute values.

An optional user-installable 1K RAM memory module is $19.95, for expanding the PC-4's 544-step, 26-variable-memory RAM to up to a maximum of 1568 possible steps or up to 222 variable memories.

A $39.95 cassette interface permits storing and loading programs at 300 baud using an optional cassette recorder. A PC-4 printer, at $79.95, prints 20 characters per line using an electro-thermal 5 by 7 dot matrix. The PC-4, printer and cassette interface plug together to form a unit $1^7/_{16}$" by $6^3/_4$" by 7", which fits into a $7.95 padded vinyl carrying case with zipper opening.

Although Sharp has marketed their PC-1211 separately, along with the PC-1500, which is the same as Radio Shack's PC-2, the PB-100 will not be sold with the Casio name nor through Casio dealers.

Word Processing

If you use a typewriter several times a week, or more, you should look into Radio Shack's word processing software. You can save a great deal of time and trouble, especially with form letters.

If you are a writer, you can avoid most of the problems of changes and corrections. You make them all on the screen and when the final version is ready, you can then print it out for the first (and last) time, unless intermediate versions are required. No more erasing, strikeovers, or messy correcting fluids.

Typing on a word processor is much

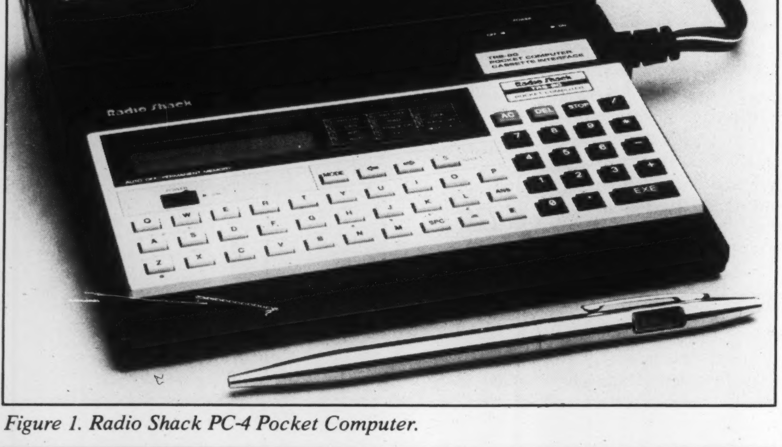

Figure 1. Radio Shack PC-4 Pocket Computer.

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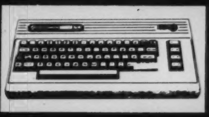

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faster than using a typewriter, because you don't have to worry about making mistakes (unless you are a very poor typist). You can correct the mistakes later, add or delete words and sentences, move paragraphs around, and much more.

Radio Shack offers two word processing programs on disk for the Models III and I: the "affordable" *Scripsit* at $99.95; and the advanced $199 *SuperScripsit*, introduced last fall. There is also *Scripsit* for the Model II and 12 ($399), the Color Computer ($39.95 on cassette, $59.95 on disk), and on cassette for the Model III or I, for $39.95.

Scripsit

If your word processing needs are simple, you can do a great deal with *Scripsit* (June 1980, p. 166). I have been using the "affordable" version on a Model III since March, 1982, for these columns and the book reviews. Now I find it very difficult to go back to a typewriter, after having enjoyed the considerable advantages of word processing.

Using *Scripsit*, you can also right-justify text, center lines, hyphenate words at the end of lines, set tabs, number pages automatically, print headers and footers automatically, and that's only part of it.

With Global Replace, you can replace every occurrence of a word with another word, such as changing all "Democrat" references to "Republican." With just a couple of keystrokes, you can change the width of the text displayed on the screeen, which takes place before you can take your finger off the ENTER key.

SuperScripsit

For some users, *SuperScripsit* is the way to go, because of its many, many advanced document and printing features. It can handle true proportionally-spaced printing. And because it uses control codes embedded in the text, it can switch back and forth from one specification to another, such as changing line-spacing (including half spaces) as often as you wish.

SuperScripsit supports underlining, double underlining, boldface, superscripts and subcripts, and multiple-column printing, if you have the right printer. Documents up to 30,000 words long can be saved on a Model III disk.

The SuperScripsit Package

For $199, you get a training program of eight lessons on audio cassette, with an accompanying "Figures Book" text, plus a 158-page reference manual, *SuperScripsit* and TRSDOS on disk, a short summary of commands on a fold-out reference card, and Proofread disks for checking spelling with the $149 *Scripsit Spelling Dictionary*.

The audio cassettes provide a self-paced training course, with detailed, step-by-step instructions, and assume you have never even seen a TRS-80 Model III before. The narrator on the tapes refers often to the figures, which may recap an instruction you have just practiced, list the steps for entering an instruction, provide exercises to use during the lessons, illustrate the ideas being discussed, or provide a review at the end of a lesson.

The tape lessons take quite a while to use, because every now and then you are asked to turn off the recorder and either read some text, or do a typing assignment. It is possible to learn *SuperScripsit* from the reference manual alone, just as it is possible to build a Heathkit television set without following the manual, but the tapes are highly recommended.

May I See A Menu Please?

To use *Scripsit*, you are advised to put self-sticking decals on 17 keys on your keyboard, so you'll know which keys to press for inserting, deleting, exchanging, repeating, starting a block, tabbing, etc.

SuperScripsit eliminates the decals by using menus, which make everything much easier. The first menu (Figure 2) offers seven choices.

If you press the letter O, you get a second menu (Figure 3).

After you have identified and described your document in the first four lines, you can change the various options or leave them at their default values. After you lock in the options by pressing ENTER, the old document comes to the screen, or you are ready to create a new one.

The screen (Figure 4) shows a cursor at top left, and a tab line and status line at the bottom.

As the cursor moves along the typing line, a "ghost" cursor moves along the tab line, to let you know how close you are to a margin (left and right parentheses), a tab (+), or the indent tab (I).

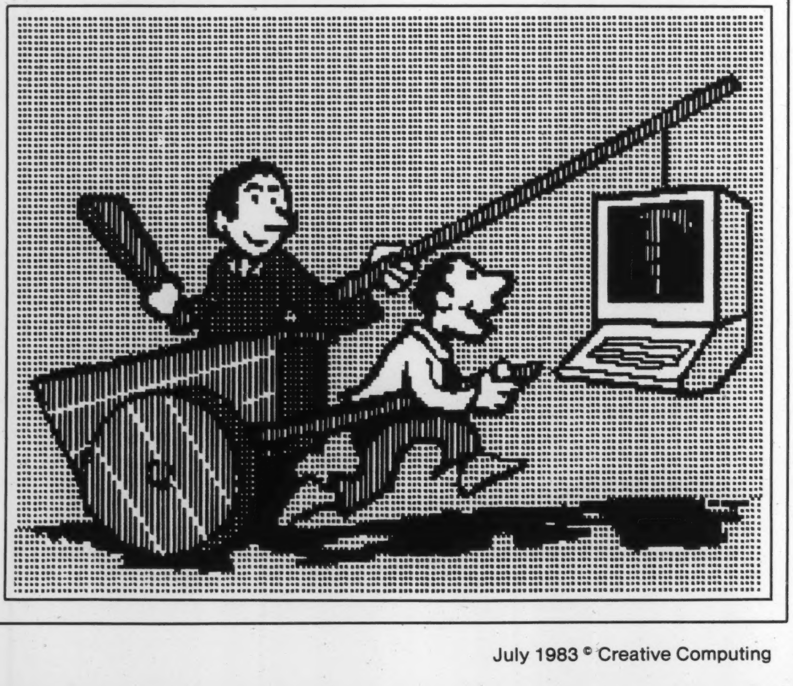
The lower line is the status line, which displays the document name (PAGE) and tells you which page and line you are on, the horizontal cursor position in inches, the pitch at which the document will be printed, and the linespacing.

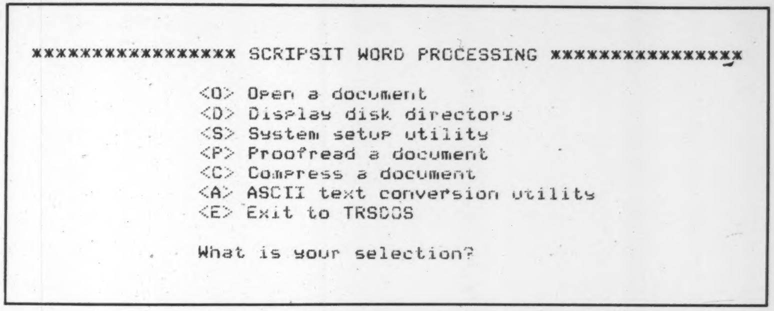
Added Niceties

The authors of *SuperScripsit* have added a great many sophisticated details that will be appreciated by anybody who has done a fair amount of word processing. Some of these features have been borrowed from dedicated word processing machines.

Once you start preparing text, you have 21 cursor movements available. In addition to the usual four (controlled by the four arrow keys), you can move the cursor to the end or beginning of the document, to the left or right margin, to the next tab, to the next (or previous) word, paragraph, page, or video page, or to a header or footer page, line number, or specific page.

Any time you are not sure what you are doing, just type @H and you get assistance in the form of seven Help screens that provide a complete list of



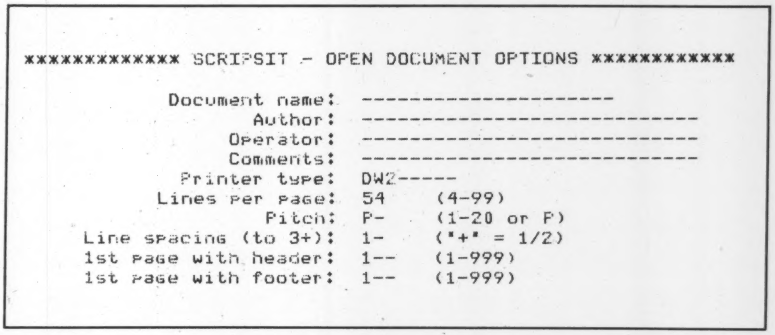


```
****************** SCRIPSIT WORD PROCESSING *****************

                  <O> Open a document
                  <D> Display disk directory
                  <S> System setup utility
                  <P> Proofread a document
                  <C> Compress a document
                  <A> ASCII text conversion utility
                  <E> Exit to TRSDOS

                  What is your selection?
```

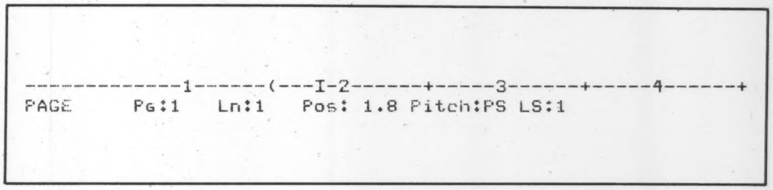
Figure 2. The first menu of the SuperScripsit *word processing program (called* Scripsit *on the screens) is the Main Menu, which can be bypassed if you request a document by name when loading the program.*



```
************* SCRIPSIT - OPEN DOCUMENT OPTIONS ************

             Document name:  --------------------
                    Author:  ---------------------------
                  Operator:  ---------------------------
                  Comments:  ---------------------------
              Printer type:  DW2-----
            Lines per page:  54     (4-99)
                     Pitch:  P-     (1-20 or P)
      Line spacing (to 3+):  1-     ("+" = 1/2)
      1st page with header:  1--    (1-999)
      1st page with footer:  1--    (1-999)
```

Figure 3. Selecting 0 on the Main Menu brings up the menu of Open Document Options to be selected when opening a new or existing document.



```
-------------1------(---I-2------+-----3------+-----4------+
PAGE      Pg:1   Ln:1   Pos: 1.8 Pitch:PS LS:1
```

Figure 4. The SuperScripsit *standard screen format for displaying text includes a tab line to show where margins and tabs are, and a status line that keeps track of important data such as page and line.*

commands and functions.

With "align tabbing," *SuperScripsit* automatically lines up, for example, decimal points in a column of prices.

Deletions are performed fast and neatly. Just hold down @ and D, and the characters to the right of the cursor move left and disappear when they get to the cursor.

To move a block of text, *SuperScripsit* writes it to disk, then puts it where you have positioned the cursor. Using the same technique, you can copy a block to make it appear in more than one place.

A paragraph can be "frozen" so it can't be changed in any manner.

Fancy Printing

For me, some of the most attractive features of *SuperScripsit* are the advanced printing features. When I prepare this column to send it to Morris Plains, I've had to mark the text to indicate which words are in boldface, which in italic, etc.

With *SuperScripsit,* I just insert print-control codes in the text, and the codes take care of all that.

Before and after text you want to print bold, just press CLEAR and +. The printer automatically overprints each character three times.

To underline (for italics), just press CLEAR and —, and the printer backs up after printing each character and underlines it. For double-underlining, use CLEAR= (this feature is available only on the Daisy Wheel II printer).

Superscripts and subscripts are just as simple. For superscripts, press CLEAR and *, and the printer will move the paper down half a line and print until a CLEAR and a period are encountered. Subscripts are handled in just the opposite fashion: CLEAR. makes the printer move the paper up half a line and print until CLEAR* is reached. Thus you can easily print technical expressions that would otherwise have to be done by hand:

Technical.

Try this on for size:

$$X=C^2(W_o*L^{23}/(-T^*_r-V1)*W_{o3})$$

Advanced Features

The first five audio-cassette lessons cover the essentials of Startup, Basic Document Preparation, Working With Blocks and Pages, Printing, and Finishing and File Management. In the course of these lessons, you prepare several documents, and thus learn while doing.

Lesson Six gets into saving and recalling tab lines (for typing documents with complicated format requirements, such as outlines, you can save up to 11 tab lines), and global changes; you can search an entire document for a word or phrase, and replace or delete it.

Lesson Seven teaches how to program user keys and prepare form letters. The ten number keys are user-programmable in *SuperScripsit;* each can recall up to 127 characters so that frequently used words or phrases can be displayed with a single keystroke.

To prepare form letters, you type a master document that contains the standard text, with code names where variables are to be inserted. Then type a variables document containing the list of codes and the variables (such as addresses and product names) for each letter. Merge the two documents and print one letter for each group of variables.

Lesson Eight, the last, on Advanced Utilities, shows how to write your own defaults for the Open Document options, how to edit user keys once they have been programmed, and introduces the reference manual.

Scripsit and SuperScripsit

Suppose you already have *Scripsit,* which saves files in ASCII code. Can you use your *Scripsit* files with *SuperScripsit,* which has its own file format? Yes; just use the ASCII Text Conversion Utility to change your *Scripsit* files from ASCII to *SuperScripsit* format. You can use the same utility if you want to convert a *SuperScripsit* file to *Scripsit* ASCII.

The Catch

As the Figures book puts it, "Although you can print with a printer other than the Daisy Wheel II, most other printers are not equipped to handle many of *SuperScripsit*'s advanced features, such as proportional spacing and double-underscore."

SuperScripsit also has drivers for Line Printers IV and VIII, and a serial (RS-232) printer; you have to specify which in the Open Document Options. If you have a non-Radio Shack printer, the reference manual says "you may need to write your own printer driver. If your printer is a serial printer, you can use the TRSDOS utility SETCOM to configure the serial port."

As one of the very helpful people in a Radio Shack Computer Center put it, *Scripsit* is "useful as a full-screen editor for Basic programs, because it saves things directly as ASCII files. Using *SuperScripsit,* you have to convert back and forth."

To use *SuperScripsit* on the Model I, you need two disk drives. Although Model III floppy disks hold up to 170,000 characters, the Model I floppies hold only 76,000. So on the Model I, *SuperScripsit* itself takes up an entire disk, and there is no room for documents. You need one drive for the program floppy, and at least one for the documents. You also need 48K of memory for the I or III.

Although *SuperScripsit* and the Model III support up to four disk drives, you can use the program with only one drive. To use the Proofread option with the *Scripsit Dictionary,* you must have three disk drives.

However, *SuperScripsit* has so many highly useful features that once you have used it a while, you may not want to go back to *Scripsit.* And if you have used only a typewriter before, you certainly won't want to go back to that.

Lawyer's Newsletter

"The Lawyer's Microcomputer" is a 16-page publication subtitled, "A Newsletter for Lawyers Using the TRS-80." A recent issue devotes ten pages to three major articles, on "Creating a Calendar Control System with Profile Plus," "Using WordStar, DataStar, SuperSort and CP/M," and "Using Scripsit's Merge Feature."

The remainder of the issue contains a Radio Shack news release on enhancements for *Profile Plus,* a list of 53 "Software Companies of Interest to Lawyers," an announcement of a "National Conference for Lawyers Using Radio Shack Computers" (held this last May in Fort Worth), a short tutorial on how to back up a data disk that doesn't contain an operating system, and "Bits and Bytes," short items about various publications and software products.

The newsletter is well written, although the computerized text looks a little odd, having been right-justified by the insertion of more space between letters than you are likely to see elsewhere. However, it is quite neat, and does eliminate end-of-line hyphens (there is only one in the whole issue).

It is a publication that computer-toting lawyers of the TRS-80 may want to check out. It's from R.P.W. Publishing Corp., Box 1046, Lexington, SC 29072, telephone (803) 359-9941. A year's subscription, presumably for 12 issues, is $28 (U.S.); $37 (Canada); $43 (foreign).

Short Program #40: CoCo Piano

Back in May 1982 (p. 207) there was a short program that lets you play the Color Computer with a joystick, with the horizontal movement controlling pitch, and vertical movement controlling tone duration.

John Crager of West Islip, NY, sent a music program for the Color Computer that is a little different:

"I wrote this Short Program for my Radio Shack Extended Basic Color Computer. You use the numbers 1-9 for the tones, where 1 is the lowest and 9 is the highest, and use your right joystick for the duration, where the far left is a whole note and the far right is a 64th note.

"With some dexterity (enough to use the joystick in the left hand, and the right hand on the keyboard), you can use it as an electronic piano."

```
10 A$=INKEY$
20 IF A$="" THEN 10
30 IF ASC(A$)<49 OR ASC(A$)>57
   THEN 10
40 L=JOYSTK(0)+1
50 PLAY "L" + STR$(L)
60 PLAY A$
70 GOTO 10
```

"You can add the following lines 5, 15, 17 and 45 and use the spacebar to change octaves."

```
5 O=1
15 IF A$=" " THEN O=O+1
17 IF O=6 THEN O=1
45 PLAY "O" + STR$(O)
```

"I would also like to say that even though the Color Computer is fairly new, I have found very interesting little programs in the TRS-80 Strings dept., and I have found it easy to decipher the other programs in the magazine."

The joystick output isn't linear, so the change from whole note to 64th note isn't as gradual as you might like. Also, once you press a key while the joystick is at the far left, you get the maximum duration, even if you move the joystick to the far right immediately afterward.

Lines 10-30 ignore all keyboard input except numbers 1-9. Line 40 adds JOYSTK(0), the value of the horizontal coordinate of the joystick (which ranges from 0 to 63), to the Lnumber value for a whole note. Thus L ranges from 1 to 64, or from a whole note to a 64th note. To examine the JOYSTK(0) range, run this:

```
100 PRINT JOYSTK(0);
110 GOTO 100
```

and you'll see how much joystick movement there is between 0 and 1, and how very little between 62 and 63. This seems logarithmic rather than linear; the latter might be preferred for this particular application.

Lines 50-60 play a note whose duration is controlled by the position of the joystick, using the required L for note length and an Lnumber provided by STR$(L), and whose pitch is controlled by a keyboard number from 1 to 9, using A$.

Line 5 sets the pitch at octave 1. Line 15 moves the pitch up an octave if a space is keyboarded. If the pitch is at its highest range (octave 5), line 17 returns it to octave 1 if the spacebar is pressed. Line 45 contains the obligatory 0 plus the octave value.

Note that STR$ is required for L and 0 because PLAY is a string function. Note also that there is a space between the quotation marks in line 15; remove the space and you get some very peculiar results. Can you figure out why? ☐

"All I want is a yes or no answer!"

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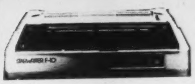

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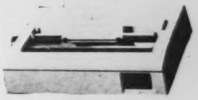

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iews...book re

Steve Gray

Logo: An Introduction, by J. Dale Burnett. Creative Computing Press, Morris Plains, NJ. 67 pages, paperback $7.95. 1982.

The front cover says this book is "For teachers, students and other computer users new to the philosophy and methodology of Logo." The back cover says it's a "first-of-its-kind primer...specifically designed as a practical guide for the teacher using Logo in the classroom or computer lab."

Logo is a highly interactive language that uses a triangle-shaped cursor called a "turtle," and graphics that "teach logical thought processes and problem solving."

The book, meant for hands-on use, has large type like a child's book, but the language is more that of the elementary or junior high school teacher; for example, it says, of the turtle cursor, "its gender is in the eye of the beholder."

The book is divided into 16 sections, on Getting Started, Soft Saves (saving a procedure); Powerful Idea #1 (combining a simple pattern into a more complex pattern); Hard Saves (saving a Logo file on disk); Powerful Idea #2 (variable inputs); Rotating Polygons About a Vertex; Symmetry; Curves; Cartesian Coordinates and Polar Geometry; A 2-Person Game; Powerful Idea #3 (recursion); Arithmetic and Logic (plotting functions); Turtle Races; Literacy (creating large letters); Alphabets, Words, and Sentences (text manipulation); Question and Answer Procedures (creating a quiz).

The emphasis is on doing, right from the beginning; after four pages on the basics, the reader is asked to draw over a dozen figures, from a line to a circle to a picture. Each new concept is followed by ways of using it in Logo, with printouts, drawings, and callouts to help the reader understand exactly what he is doing. Hints are given for some exercises, but the majority ask only, for example, "How many ways can you make a checkerboard?"

Even without a computer, the reader gets a fine understanding of what Logo is and how to use it. With a computer, the book provides an excellent primer of Logo basics, by making the reader do most of the work.

Microcomputer Graphics, by Roy E. Myers. Addison-Wesley Publishing Co., Reading, MA. 296 pages, paperback $11.95. 1982.

The title of this latest of Addison-Wesley's Microbooks is somewhat misleading. It's not a general text on microcomputer graphics, but, as the slash on the corner of the cover indicates, it is "With Apple II Examples," which means that all the examples are written in Applesoft Basic. The back cover says the book "fully explains the graphics capabilities of the Apple II while introducing the mathematical and programming techniques central to computer graphics."

The nine chapters are divided into six parts: Introduction (The World of Microcomputer Graphics), The Computer

eviews...book

(Graphics Characteristics of the Apple II, Text on the Graphics Screen), 2-D Graphics (Software Tools for Computer Graphics, Analytic Geometry and Computer Graphics), 3-D Graphics (Basics of 3-D Graphics, Hidden Line and Hidden Surface Routines), Animation (Animated Images), and Peripheral Equipment and Software (System Components). Six appendixes provide information on number systems, shape tables, vectors, matrices, radian measure of angles, and program listings for the six images on the front and back covers.

As the chapter titles show, this is not like most of the personal computer graphics texts, which don't get much beyond what is in the first three chapters of this book, plus perhaps a little on animation. Myers assumes a knowledge of Basic, and starts right off with short programs for creating a bouncing ball and a space ship. Depending on the reader's knowledge of Basic and programming, he may find the going a little tough once he gets to the chapter on Software Tools. However, Myers gives about as much help with matrices as can be expected without presenting a course on the subject. And when he gets to the 3-D chapter, he starts with a notice, "Warning—read sowly, mathematics ahead," and adds, "The process of displaying three-dimensional images requires additional mathematics. As is usual when traveling in rough terrain, we will progress more rapidly if we move slowly and carefully."

This is the best book of its kind seen so far by this reviewer, who would like to see it "translated" for several other personal computers. Myers makes a difficult subject comparatively easy to understand, and writes as simply as possible.

The book includes 73 programs, and a disk containing them all is available from the author for $15.

My Computer Dictionary, by Jean Rice and Marien Haley. T.S. Denison & Co., 9601 Newton Ave. S., Minneapolis, MN 55431. 32 pages, paperback $3. 1981.

As the title indicates, this is a children's dictionary of computer terms, with several illustrations per page. Although most books with similar titles are for young children, this one is for children who can read. The 47 illustrations include photographs, drawings, flowcharts and brief programs.

The illustrations are all quite good, including photographs of computers, peripherals of media, and drawings of a joystick, light pen, keyboard, etc., although photographs could have been used in place of many of the drawings.

Most of the definitions are simple, straightforward and good. *Address* is defined as "a number or name that tells where to find a place in a computer's memory. It is like a house **address** that tells where to find the house." A bug is "a mistake in a computer program. The **bug** must be corrected before the computer can use the program properly."

Some definitions are a little misleading, although by very little. An acoustic coupler is said to "change information into signals," and a microprocessor is described as being "about the size of a band-aid."

However, all things considered, this dictionary is a useful tool

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for helping the student understand computer texts that have no glossary, or an inadequate one. The definitions are all quite reasonable, and aren't written, as in some other dictionaries, with words that must sometimes be looked up themselves.

This book is also useful to the average person who has heard some of these words and wants to know what they mean without getting a long, technical description. School libraries should also find it a help.

Computers are Fun, by Jean Rice and Sandy O'Connor. T.S. Denison & Co., 9601 Newton Ave. S., Minneapolis, MN 55431. 62 pages, paperback $3.95. 1981.

Teacher's Guide and Activity Book to accompany *Computers are Fun*, by Rice and O'Connor. T.S. Denison & Co. 92 pages, paperback $12. 1981.

Designed to introduce computer literacy to very young children (kindergarten through grade three). the student text is a hi-tech version of "See Spot run." The first paragraph starts:

> Here are Bill, Kim and Jan. They are all friends. They are playing a computer game. Jan's Dad, Mr. Hanson, is watching. "Look at the ball. It moves up and down on the TV," said Jan. Dad said, "This game has a computer inside. The computer makes the ball move. There are many other games that have a computer inside."

And so the book goes, with many large photographs of large and small computers and peripherals, and many drawings of teachers and students, of products that use computers (microwave oven, airplane, spaceship), flowcharts, etc.

The six chapters discuss how computers help us, computer history, parts of a computer system, microcomputers, flowcharts, and programs. One three-line Basic program prints the answer to two simple additions, and a two-liner prints the title of the book.

The guide contains day-by-day minimum-time-frame unit outlines for students in kindergarten and grades 1, 2, and 3. A third of the book is devoted to activities for each chapter, and includes objectives, tells which of the 27 full-page duplicating masters to use, gives words to learn, a detailed activity guide to the student-text pages, review questions, a chapter summary, and a crossword puzzle that uses new words introduced in that chapter.

However, many of the masters involve math exercises that aren't relevant and are of little educational value to the subject. Master E presents a maze; H and I involve counting with stones; L requires coloring several computer lights red; O requires printing your name as many times as you can in a minute, etc., etc.

The guide also contains 16 pages of reference material: films on computer topics; filmstrips and other multi-media, a bibliography; and a glossary. But most of the films and filmstrips listed are not for young children.

The text is a good introduction to computer technology, if the child can read it. But the activity guide isn't worth the $12; any competent teacher could read the text, learn from it, and come up with activities on her own.

Exploring the World of the Personal Computer, by Jack M. Nilles. Prentice-Hall, Inc., Englewood Cliffs, NJ. 249 pages, paperback $12.95.

The back cover says this is a "review of low-cost computers as their usage expands in the present, and a forecast of the potential implications inherent as they proliferate."

The 14 chapters are divided into three parts: Personal Computers and Personal Computing (the information society, personal computers, personal computers in the home), Uses (office computers, fun and games, learning via personal computers, more about home personal computers, medical uses), Reflections (Big Brother, the have-nots (personal computers as luxuries), international personal computers, standards, personal computers and mental health, blaming the computer). A brief epilog discusses whether the personal computer is friend or foe, followed by a glossary and "bibliography and recommended reading" section.

The author, a senior research associate at USC's Center for Futures Research, takes a middle-of-the-road approach, presenting the personal computer as neither a scary privacy-invading monster, nor a simple tool we can all easily cope with. In his last paragraph, he says, "As with all powerful technologies, we can use it for our ultimate good or we can do a great deal of harm with it. Almost as bad, we might do only trivial things with it."

Nilles uses the scenario technique to help the reader evaluate the personal computer as a factor for his lifestyle, and then keys dialogs to the scenarios, as a way of presenting arguments for and against a particular application.

This book is recommended to those who want a thoughtful, conservative, realistic look at the present and future of personal computers, presented quite well in just over 200 pages of main text.

Microcomputer Graphics and Programming Techniques, by Harry Katzan Jr. Van Nostrand Reinhold Co., New York, NY. 237 pages, hardcover $18.95. 1982.

The press release says this "first easy-to-understand reference offers a non-technical introduction to computer graphics technology." Well, it isn't all that easy, and the programs were written for the Apple II Plus computer, which has built-in graphics commands that simplify programming considerably.

Although the jacket says "it doesn't matter if you've never looked at a computer before," it would help to know something about computers before you tackle this book, which more closely resembles a college textbook than an easy guide.

For example, the introductory chapter includes a state diagram showing the "operational modes of the computer in response to various forms of input," which is much too technical for such a book, and isn't explained at all. The second algorithm in the next chapter, on applications and programming concepts, generates Fibonacci numbers; a program for doing the same starts off the fifth chapter, on Basic.

The book seems to have been written around the two dozen programs in the last four chapters, which are about lo-res and hi-res graphics, animation, and 2-D and 3-D transformations. They include the game of *Life*, stereo effect, generating "visual white noise" (random lines), string art, moving birds and dogs (animation), etc. The last chapter, on image transformation (translation, rotation, scaling), includes two fine programs for 2-D and 3-D transformations, but they aren't explained at all. And two important figure captions are transposed, adding to the complexity.

This book can be recommended if you have some knowledge of programming, and want to learn something about graphics, but aren't willing to learn enough about vector math and matrices to understand, for example, the outstanding $19.95 "Graphics Software for Microcomputers," by B.J. Korites (reviewed February 1982, p. 220). □

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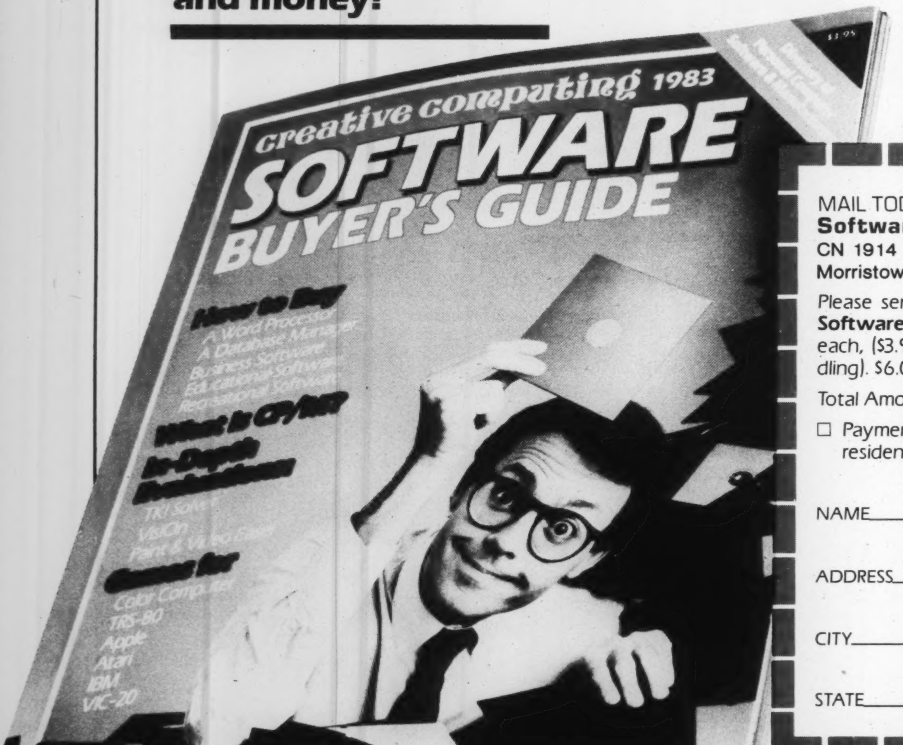

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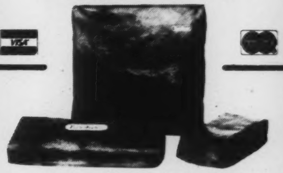

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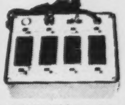

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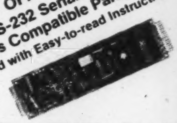

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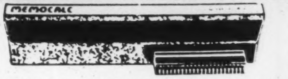

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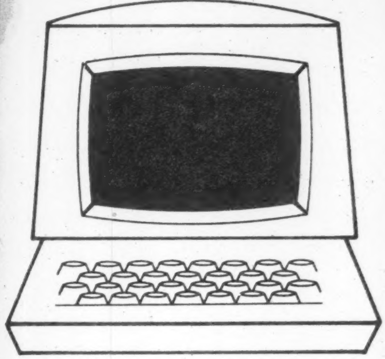
• index to advertisers •

Reader Service No.	Advertiser	Page
101	Aardvark	102
107	AB Computers	208
102	Abacus Associates	247
*	Accent Software	46
104	Access Unlimited	123
103	Adventure International	59
106	Adwar Video Corp.	18
*	ALF Products	239
108	Allenbach Industries	143
287	Alpha Byte Computer Products	229
111	Amdek	45
110	American Small Business Computers	207
315	Anidata	264
109	Anthro Digital	151
113	Apple Computer, Inc.	90-91
115	Appleware, Inc.	232
114	Archive	38
*	Artworx	17
116	Atari	57
117	Atlantic Computer Accessories	144
118	Ballantine/Del Rey Books	217
119	Beagle Brothers	203
122	Big Five Software	2
121	Blythe Valley	10
125	BMC/USA, Inc.	269
154	The Book Company (Continental Software)	163
123	Broderbund Software	42
124	BRS/After Dark	23
127	Byte-Back Company	207
120	Bytewriter	264
131	Cab-Tek	251
128	Calsoft	193
129	Carolina Microsystems	147
180	Century Micro	58
136	Chrislin Industries	98
288 & 130	C-Load Magazine	79
140	Commodore Business Machines	85
132	Communications Electronics	105
134	CompuPrint	247
142	CompuServe	118-119
141	Computer Advanced Ideas	29
133	Computer Book Club	199
144	Computer Discount Products	223
147	Computer Entrepreneur Publishing Company	259
135	Computer Exchange	74-75
137	Computerline	253
138	Computer Mail Order East/West	106-107
139	Computer Outlet	194-195
145	Computer Plus	207
151	Computer Store	132
143	Computronics	C3
153	Comstar	44
146	Cosmic Computers Unlimited	82
	Counterpoint Software	84
149	Cowtown Software	247
186	Creative Video	172
150	Data, Design & Development	36
157	Datamost	86
158	Datamost	173
155	Datasoft	160
156	DDL Software, Inc.	18
159	Decision Support Software	243
152	Designware	120
*	Digital Equipment Corp.	15
169	Discwasher	159
281	Dynacomp	277
171	Educational Media Associates	148
160	Edu-Ware Services	181
167	Electra Concepts Corp.	267
161	Electronic Arts	126-127
126	Electronic Protection Devices	153
172	Electronic Specialists	234
205	Epson America	220-221
176	EPYX	39
163	Executive Peripheral Systems	255
164	Express Software	251
165	Fastrack Computer Products	69
166	Finetech, Inc.	189
178	FlipTrack Learning Systems	81
170	Fox Games	262-263
168	Franklin Computer Corp.	32
173	General Technology	272
174	General Videotex	191
189	Greenwood Manufacturing	198
183	Happy Hands	148
175	Harmony Video & Electronics	289
177	Hayes Microcomputer Products	60-61
179	Indus-Tool Corp.	234
181	Infocom	52-53
182	Interactive Structures	128
184	Ironsides Computer Corp.	271
185	Jade Computer Products	186-187
199	JRT Systems	92
203	Kensington Microware	156
187	Koala Technologies	113
190	Leading Edge	C4
188	Leading Edge	9
201	LNW Research	140
202	LNW Research	47
191	Lyben Computer Systems	18
192	Lyco Computer	170-171
*	Macmillan Book Clubs	65-67
230	Magic Computer	236
209	Marymac Industries	72
211	Micro D	19
193	Micro Lab	137
223	Micro Learningware	151
194	Micro Management Systems	295
195	Micro Merchant	273
196	MicroPrice	293
197	Micro Sense	129
221	Microware Distributing	183
222	Micro Works	78
198	Municipal Information Services	294
200	Muse Software	95
204	National Computer Products	247
206	National Education Corp.	145
207	NEBS Computer Forms	251
208	Nonagon	116
218	Odesta	149
210	Ohm/Electronics	50
212	Okidata	114
*	Omega Sales	174
236	Pacific Exchanges	151
236	Pacific Exchanges	152
236	Pacific Exchanges	158
236	Pacific Exchanges	225
213	Peachtree Associates	158
234	Perry Oil & Gas	294
235	Phoenix Performance Systems	265
214	PMI, Inc.	54
240	Practical Peripherals	1
215	Program Design	297
216	Programmer's Institute	101
217	Programmer's Institute	73
219	Protecto Enterprises	77
220	Protecto Enterprises	213
224	Protecto Enterprises	296
225	Quadram Corp.	20-21
249	Quark, Inc.	40-41
226	Radio Shack	31
228	Refco	152
229	Reston Publishing	35
231	Reston Publishing	62
232	Reston Publishing	184
233	Reston Publishing	164
237	R.H. Electronics	233
282	R.H. Electronics	235
238	Robographics	192
255	Roland Corp.	178
239	Royal Software	93
289	Safeware	225
241	Sakata U.S.A.	30
242	Howard W. Sams & Company	71
243	Sierra On-Line, Inc.	5
244	Sierra On-Line, Inc.	167
245	Sierra On-Line, Inc.	94
246	Sirius Software	25
247	SJB Distributors	215
248	Snave Systems	83
250	Snave Systems	158
251	Snave Systems	225
252	Softrent	198
253	Software Services	152
254	Software T'Boot	265
257	Southern California Research Group	237
256	Southern California Research Group	232
258	SouthWest Microsystems	207
259	Spectra Video	177
261	Spectra Video	C2
*	Spinnaker Software	12-13
276	SSM Microcomputer	70
284	SSM Microcomputer	88
285	Star Micronics	134
260	Strategic Simulations, Inc.	51
262	Strobe, Inc.	168
263	Sub Logic	125
286	Sydney Data Products	150
264	Synapse Software	11
265	Synapse Software	133
266	Systems IV Limited	108
267	Systems Group	245
268	Tactical Design	129
269	Tech Sketch	265
270	Tecmar	7
272	Thorn EMI Video, Inc.	210-211
273	Transtar	110
274	Tronix	26-27
275	Ultra Magnetics	256-257
277	United Computer Corp.	49
278	Universal Software	97
283	Videx	261
296	Warlock Software	145
280	Xerox Service Center	138-139



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151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175
176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200
201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225
226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250
251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275
276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300
301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325
326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350
351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375
376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400
401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425
426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450
451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475
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151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175
176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200
201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225
226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250
251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275
276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300
301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325
326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350
351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375
376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400
401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425
426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450
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151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175
176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200
201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225
226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250
251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275
276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300
301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325
326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350
351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375
376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400
401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425
426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450
451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475
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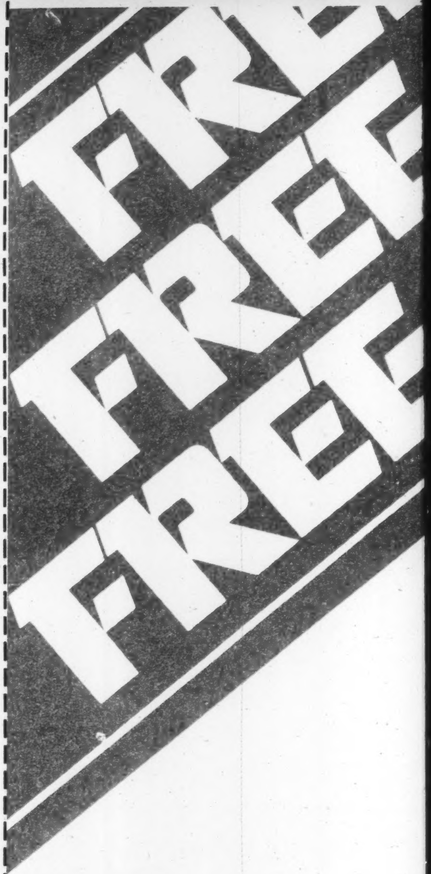

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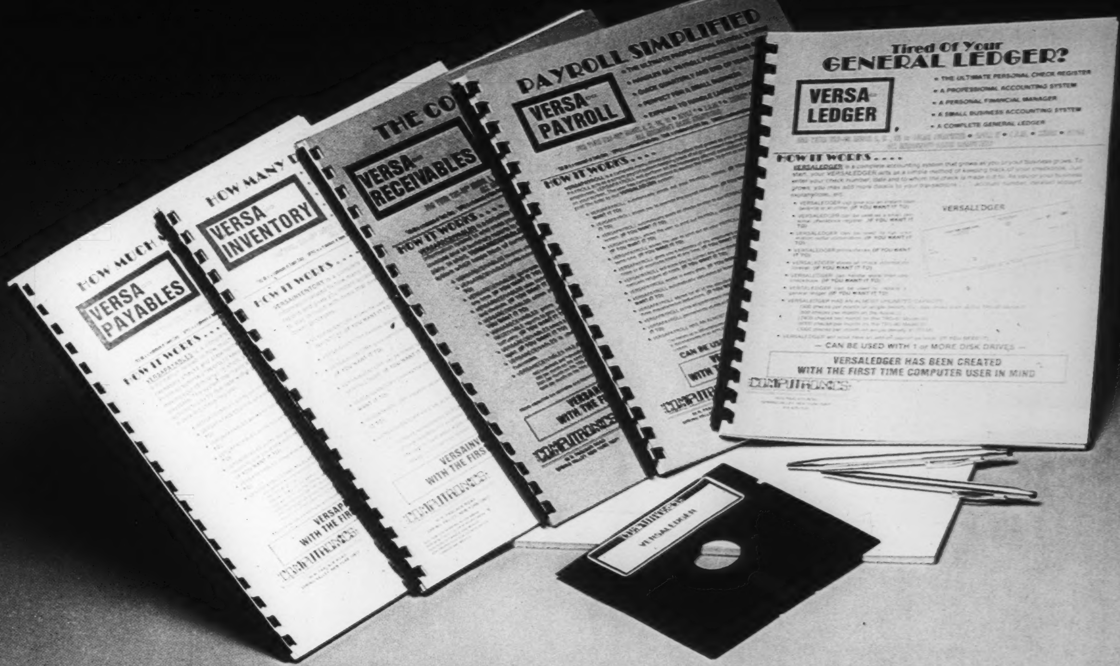

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